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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte KATSUYUKI MUSAKA and SHINSUKE MIZUNO

Appeal 2007-3582
Application 09/187,551[1]
Patent 5,571,571
Technology Center 1700

Decided: January 14, 2008

Before BRADLEY R. GARRIS, *Administrative Patent Judge*,
FRED E. MCKELVEY, *Senior Administrative Patent Judge*, and
ALLEN R. MACDONALD, *Administrative Patent Judge*.

MACDONALD, *Administrative Patent Judge*.

DECISION ON APPEAL

We Affirm.

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[1] The real party in interest is Applied Materials, Inc. Appeal Brief (filed May 28, 2002), page 1.

I. STATEMENT OF CASE

A. *Introduction*

1. Applicants appeal from a final rejection entered June 12, 2001.

2. The reissue application on appeal seeks to reissue U.S. Patent 5,571,571, issued November 5, 1996, based on application 08/259,584, filed June 14, 1994, as a continuation-in-part of application 08/184,331, filed January 19, 1994, now abandoned.

3. The reissue application contains claims 1-10, 27-29, and 31-34.

4. The Examiner has rejected claims 1-10, 27-29, and 31-34.

5. No claims have been indicated as being allowable.

6. Appellants filed an Amended Appeal Brief (the Brief) on May 28, 2002, fully replacing an Appeal Brief filed January 24, 2002, a Reply Brief (the Reply) on December 30, 2002, and a Supplemental Reply Brief (the Supplemental Reply) on June 13, 2005.

B. *Rejections*

7. The Examiner has rejected reissue claims 27-29 and 31-33 of the reissue application on appeal as being unpatentable under 35 U.S.C. § 251 on the grounds that these claims seek to recapture subject matter surrendered when the patent sought to be reissued was granted.

8. The Examiner has rejected claims 27-29 and 31-34 under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the Specification in such a way as to reasonably convey to one skilled in the relevant

art that the inventors, at the time the application was filed, had possession of the claimed invention.

9. The Examiner has rejected claims 27-29 and 31-34 under 35 U.S.C. § 251 as being based upon new matter added to the patent for which reissue is sought.

10. The Examiner has rejected claims 27-28 and 31 under 35 U.S.C. 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) or (e), on the grounds that these claims are unpatentable over Homma (EPO 517,548 A2 or U.S. Patent 5,288,518).

11. The Examiner has rejected claims 1-10, 27-29 and 31-34 under 35 U.S.C. § 103(a) on the grounds that these claims are unpatentable over U.S. Patent 5,429,995, to Nishiyama et al (Nishiyama).

12. The Examiner has rejected claims 27-29 and 31-34 under 35 U.S.C. § 103(a) on the grounds that these claims are unpatentable over Weise (WO 92/20833).

C. *Issues*

13. The first issue before the Board is whether Appellants have established that the Examiner erred in rejecting claims 27-28 and 31 under 35 U.S.C. 102(b) or, in the alternative, under 35 U.S.C. § 103(a) or (e), as unpatentable over Homma.

14. The second issue before the Board is whether Appellants have established that the Examiner erred in rejecting claims 1-10, 27-29 and 31-34 under 35 U.S.C. § 103(a), as unpatentable over Nishiyama.

15. The third issue before the Board is whether Appellants have established that the Examiner erred in rejecting claims 27-29 and 31-34 under 35 U.S.C. § 103(a), as unpatentable over Weise.

16. The fourth issue before the Board is whether Appellants have established that the Examiner erred in rejecting claims 27-29 and 31-34 under 35 U.S.C. § 112, first paragraph.

17. The fifth issue before the Board is whether Appellants have established that the Examiner erred in rejecting claims 27-29 and 31-34 under 35 U.S.C. § 251 based upon new matter added to the patent.

18. The sixth issue before the Board is whether Appellants have established that the Examiner erred in rejecting claims 27-29 and 31-33 under 35 U.S.C. § 251 based on recapture.

D. *Result*

19. The panel affirms the decision of the Examiner as to the first issue.

20. The panel affirms the decision of the Examiner rejecting claims 1-10 as to the second issue. The panel reverses the decision of the Examiner rejecting claims 27-29 and 31-34 as to the second issue.

21. The panel reverses the decision of the Examiner as to the third issue.

22. The panel affirms the decision of the Examiner as to the fourth issue.

23. The panel affirms the decision of the Examiner as to the fifth issue.

24. The panel affirms the decision of the Examiner as to the sixth issue.

II. FINDINGS OF FACT

The following findings of fact are supported by a preponderance of the evidence.

A. *The Invention*

1. According to Appellants, the invention relates to a method of forming a thin film for a semiconductor device. More particularly, this invention relates to a plasma-enhanced chemical vapor deposition (hereinafter PECVD) method for forming a silicon oxide thin film on a semiconductor substrate. (U.S. Patent 5,571,571, col. 1, ll. 8-12.)

2. PECVD provides a well known method of depositing a thin film. A body is placed in a vacuum reaction chamber and a reaction gas is introduced into the chamber. The gas is activated by means of a plasma discharge created in the chamber. This causes the reaction gas to react and deposit a thin film of a material on the surface of the body. (Col. 1, ll. 16-21.)

3. The well known methods of creating a plasma in the reaction chamber for PECVD include the method in which an electric power source having a frequency of 13.56 MHz or other frequency is applied to a pair of opposed electrodes within the reaction chamber. The deposition rate and the quality of the deposited thin film can be controlled by adjusting the power of this electric power source. (Col. 1, ll. 22-28.)

4. Another well known method of creating a plasma in a reaction chamber uses a microwave radiation of 1.54 GHz, introduced into the reaction

chamber by means of a wave guide. This method is known as ECR plasma CVD. (Col. 1, ll. 28-32.)

5. Well known gases used to deposit a thin film of silicon oxide on a semiconductor substrate include alkoxy silicates such as tetraethylorthosilicate, $(C_2H_5O)_4$ –Si, (hereinafter TEOS) and silane, SiH_4. (Col. 1, ll. 32-35.)

6. The invention can be understood by reference to Figures 1A to 1F, 3, 4A to 4F, 6, and 13, of the drawings, all of which are reproduced in Appendix 1 of this opinion.

7. The patent indicates that in one embodiment of the method of the present invention, a plasma is created within a reaction chamber by means of two electrical power sources having different frequencies. A high frequency of about 13.56 MHz and a low frequency of between about 50 KHz and about 1000 KHz, preferably about 400 KHz, are used. A reaction gas comprising a mixture of TEOS and a halogen-containing gas selected from a fluorine, a chlorine or a bromine gas, is introduced into the reaction chamber and subjected to the plasma. The ratio of the TEOS to halogen can vary. Suitable fluorine-containing gases include CF_4, C_2F_6, NF_3, CHF_3, CH_2F_2, F_2, SF_6 and the like. Suitable chlorine-containing gases include CCl_4, Cl_2, HCl and the like. Suitable bromine-containing gases include HBr and the like. (Col. 4, l. 54, to col. 5, l. 3.)

8. Figs. 1A, 1B, 1C, 1D, 1E and 1F are cross-sectional views of semiconductor devices formed by a prior art PECVD method with the devices having conductive strips of various widths and various spacings using silane as a plasma precursor gas source of silicon. (Col. 3, l. 66, to col. 4, l. 3.)

9. With reference to Figs. 1A to 1F, there are shown sectional views of semiconductor devices 10a to 10f, each comprising a substrate 12a to 12f having a layer 14a to 14f of an insulating material, such as silicon oxide, on a surface 16a to 16f thereof. A plurality of spaced, parallel lines 18a to 18f of a conductive material, such as aluminum, are on the insulating layers 14a to 14f, and are in turn coated with a layer 20a to 20f of an insulating material, such as silicon oxide. The conductive strips 18a to 18f have different widths, strip 18a being the widest and strip 18f being the narrowest. In addition, the spacing between the conductive strips 18a to 18f varies as well, the strips 18a being spaced apart the greatest distance and the strips 18f being spaced apart the closest distance. (Col. 1, ll. 51-64.)

10. The insulating coatings 20a to 20f were formed by conventional PECVD wherein a reaction gas of silane (50 sccm) and oxygen at a flow rate one-tenth that of silane was passed into a reaction chamber held at a pressure of 3 Torr. A single 13.56 MHz frequency electric power source between a pair of opposing electrodes spaced 180 mils apart in the chamber was used to form a plasma between the electrodes. (Col. 1, l. 64, to col. 2, l. 4.)

11. The patent indicates that it is believed that because silane is very reactive, the oxidation reaction occurs in the gaseous phase, producing the non-uniform, poor deposition profiles seen in FIGS. 1A to 1F. The patent also indicates the use of silane as the reaction gas for deposition of silicon oxide films over conductive metal lines has severe limitations as devices on a semiconductor

substrate become smaller and more devices are produced on a single substrate. (Col. 2, ll. 19-23.)

12. Fig. 3 is a schematic sectional view of one form of a deposition apparatus having multiple power sources which can be used to carry out the method of the present invention. (Col. 4, ll. 10-12.)

13. Fig. 6 is a schematic sectional view of a deposition apparatus having a single power source which can be used to carry out the method of the present invention. (Col. 4, ll. 21-23.)

14. With reference to Fig. 3, deposition apparatus 34 comprises an insulated deposition vessel 36 having an airtight reaction chamber 38. A pair of electrodes 40 and 42 are in spaced, substantially parallel relation within the reaction chamber 38. The electrode 40 serves as a support for a body 44, such as a semiconductor substrate, on which a coating is to be deposited, and is connected to ground potential. The electrode 42 has an inlet tube 46 extending therefrom and out of the vessel 36 through which a reaction gas can be admitted into the reaction chamber 38. An outlet tube 48 extends from a wall of the reaction vessel 36 to permit gases to be exhausted from the reaction chamber 38. A heater 50 is provided along the electrode 40 to control the temperature of the body 44 during deposition. (Col. 5, ll. 20-33.)

15. The electrode 42 is connected to a first power source 52 for providing a high frequency, typically about 13.56 MHz, oscillation to the electrode 42. The electrode 42 is also connected to a second power source 56 for providing a lower frequency, typically about 400 KHz, oscillation to the electrode 42. By

simultaneously applying to the electrode 42 electrical power of two different frequencies, i.e., high and low frequencies, a plasma is created within the reaction chamber 38. (Col. 5, ll. 34-38.)

16. The patent indicates that to deposit a layer of a material, such as silicon dioxide, on the surface of a body 44, such as a semiconductor substrate, in the apparatus 34 using the method of the present invention, the body 44 is placed in the chamber 38 and on the electrode 40. A reaction gas of a mixture of a fluorine gas, such as NF_3, and TEOS gas is introduced into the chamber 38 through the inlet tube 46. The power sources 52 and 56 are turned on to simultaneously provide a high frequency power and a lower frequency power to the electrodes 40 and 42. The ratio between the power outputs from the high frequency source 52 and the lower frequency source 56 is suitably adjusted to form a plasma within the chamber 38 and between the electrodes 40 and 42. The reaction gas is subjected to the plasma, causing the reaction gas to react and deposit a thin film of silicon oxide on the exposed surface of the body 44. (Col. 5, ll. 49-64.)

17. Figs. 4A through 4F are cross-sectional views of semiconductor devices formed by PECVD using a power source having multiple frequencies with the devices having conductive strips of various widths and various spacings in accordance with the present invention. (Col. 4, ll. 12-17.)

18. With reference to Figs. 4A to 4F, each of semiconductor devices 62a to 62f comprises a semiconductor substrate 64a to 64f, typically of silicon, having on a surface 66a to 66f thereof a layer 68a to 68f of silicon dioxide. On the silicon dioxide layer 68a to 68f are a plurality of spaced, substantially parallel strips 70a to

70f of aluminum. The aluminum strips 70a to 70f are similar to the conductive wiring of an integrated circuit. A layer 72a to 72f of silicon dioxide is coated over the aluminum strips 70a to 70f and the surface of the silicon dioxide layers 68a to 68f between the aluminum strips 70a to 70f. The aluminum strips 70a to 70f vary in width and spacing, with the aluminum strips 70a in FIG. 4A being the widest and having the widest spacing there between, and the aluminum steps 70f in FIG. 4F being the narrowest and being the most closely spaced. (Col. 5, l. 65, to col. 6, l. 15.)

19. The silicon dioxide layers 72a to 72f were deposited over the aluminum strips 70a to 70f by the above described method (See Finding of Fact 7). For this method, the pressure in the reaction chamber 38 was 5 Torr, and the spacing between the electrodes 40 and 42 was 250 mils. A flow of TEOS and a helium carrier gas at 480 sccm was provided in the reaction chamber 38. A flow of $C_2 F_6$ at 400 sccm and a flow of oxygen at 700 sccm was also provided in the reaction chamber 38. A high frequency of 13.56 MHz at a power of 80 watts was applied to the electrode 42, and a low frequency of 400 KHz at a power of 90 watts was also applied to the electrode 42. (Col. 6, ll. 16-25.)

20. When the widths of the respective aluminum strips and of the corresponding spaces between the strips are comparatively large, as shown in FIGS. 4A to 4D, the sidewalls of the silicon dioxide layers 72a to 72d have a smoothly tapered configuration. However, even when the widths of the respective aluminum strips and of the corresponding spaces between the strips is in the submicron range, as shown in FIG. 4E, the sidewall configuration of the silicon

dioxide layer 72e is straight, and the possible creation of voids is greatly reduced. When the width of the respective aluminum strips and the corresponding spaces there between is reduced even further, in the submicron range, as shown in FIG. 4F, the spaces between the aluminum strips 70f are buried by the silicon oxide layer 78f, without the formation of any voids in the film. Since the sidewalls obtained with the configurations shown in FIGS. 4E and 4F have a fine compositional structure, an enhancement of the quality is achieved. The compressive stress of the above film was found to be $1X10^9$ dynes/cm^2. (Col. 6, ll. 26-45.)

21. Fig. 13 is a graph of C_2F_6 gas flow rate versus stress of the silicon oxide films, showing reduced stress with higher C_2F_6 flow rates and higher fluorine concentration in the films. (Col. 9, lines 28-30.)

B. *Prosecution history of the original application*

22. As noted earlier, the patent sought to be reissued was based on application 08/259,584, filed June 14, 1994 ("original application"), as a continuation-in-part of application 08/184,331, filed January 19, 1994, now abandoned.

23. As filed, the original application contained claims 1-15 (reproduced in Appendix 2 of this opinion).

24. On January 10, 1995, the Examiner entered a Non-final Office action.

25. Claims 1-15 were rejected on various grounds.

26. Claims 1-15 were rejected under 35 U.S.C. § 112, second paragraph, as being indefinite.

27. Claims 1, 2 and 10 were rejected under 35 U.S.C. § 102 as being unpatentable over the following prior art:

(1) Lane et al. (Lane), U.S. Patent 4,894,352.

28. Claims 3-4, 6-12, and 14-15 were rejected under 35 U.S.C. § 103 as being unpatentable over the following prior art:

(1) Lane et al. (Lane), U.S. Patent 4,894,352 in view of

(2) Ishihara et al. (Ishihara), U.S. Patent 4,818,563 and optionally further in view of

(3) Yamazaki, U.S. Patent 4,461,783 or

(4) Kuyel, U.S. Patent 4,282,267 or

(5) Nguyen et al. (Nguyen), U.S. Patent 5,356,722.

29. Claims 5 and 13 were rejected under 35 U.S.C. § 103 as being unpatentable over Lane and Ishihara as applied to claims 1 and 11, and further in view of the following prior art:

(1) Wang et al. (Wang), U.S. Patent 4,872,947 or

(2) Weise et al. (Weise), WO 92/20833.

30. Claims 1, 2, 9, and 10 were rejected under 35 U.S.C. § 102 as being unpatentable over the following prior art:

(1) Webb et al. (Webb), Proc. Int. Sym. Ultra Large Scale Integration Sci. and Tech.

31. Claims 1 and 2 were rejected under 35 U.S.C. § 102 as being unpatentable over the following prior art:

(1) Yu et al. (Yu), VMIC Conference 1990.

32. Claims 1, 2, and 9 were rejected under 35 U.S.C. § 102 as being unpatentable over the following prior art:

(1) Lory et al. (Lory), U.S. Patent 5,013,691.

33. Claims 1-4, 9, 11, and 12 were rejected under 35 U.S.C. § 102 as being unpatentable over the following prior art:

(1) Otsubo et al. (Otsubo), U.S. Patent 5,275,977.

34. Otsubo and Nguyen are prior art vis-à-vis Applicants under 35 U.S.C. § 102(e).

35. Lane, Ishihara, Yamazaki, Kuyel, Wang, Weise, Lory, Webb, and Yu are prior art vis-à-vis Applicants under 35 U.S.C. § 102(b).

36. The Examiner found that one or more of Lane, Otsubo, Lory, Web, and Yu describe the claimed invention (claims 1-4 and 9-12) so that it is "clearly anticipated."

37. On July 11, 1995, Applicant filed an amendment responding to the Examiner's first Office action.

38. As shown in Appendix 3 of this opinion, the amendment:

(1) amended claims 1, 3, 5, 11, and 13; and

(2) cancelled claim 4.

Two new limitations being the change of “halogen” to “fluorine” in claims 1 and 3; and that the silicon oxide of claims 1 and 11 contains fluorine.

39. After entry of the amendment, the application claims were 1-3 and 5-15.

40. In the amendment, Applicants stated as follows (emphasis added):

> The claims have been amended to require that silicon oxide deposited according to the present process contains fluorine. . . . Lane et al. state they do not produce a silicon oxide layer that contains fluorine whereas applicants do.
>
> . . .
>
> Webb et al confirm that no fluorine was found in the silicon oxide deposited according to their process, see page 577, second paragraph.
>
> . . .
>
> [Similar arguments are made for Yu, Lory, and Otsubo]
>
> . . .
>
> None of the prior art suggests that fluorine is included in the silicon oxide deposited, nor suggests any role for fluorine other than improving the deposition rate.
>
> . . .
>
> Thus in view of the above amendments and discussion, applicants submit the present claims as amended are in condition for allowance.

41. On October 4, 1995, the Examiner entered a Final Office action.

42. Claims 13 and 5-15 were rejected on various grounds.

43. Claim 2 was rejected under 35 U.S.C. § 112, second paragraph, as being indefinite.

44. Claims 1, 2 and 10 were rejected under 35 U.S.C. § 103 as being unpatentable over Lane.

45. Claims 3, 6-12, and 14-15 were rejected under 35 U.S.C. § 103 as being unpatentable over Lane in view of Ishihara, and optionally further in view of Yamazaki or Kuyel or Nguyen.

46. Claims 5 and 13 were rejected under 35 U.S.C. § 103 as being unpatentable over Lane and Ishihara as applied to claims 1 and 11, and further in view of Wang or Weise.

47. Claims 1, 2, and 9 were rejected under 35 U.S.C. § 102 as being unpatentable over Webb.

48. Claims 1 and 2 were rejected under 35 U.S.C. § 103 as being unpatentable over Yu.

49. Claims 1, 2, and 9 were rejected under 35 U.S.C. § 102 as being unpatentable over Lory.

50. Claims 1-3, 9, 11, and 12 were rejected under 35 U.S.C. § 102 as being unpatentable over Otsubo.

51. The Examiner found that the claims do not distinguish over Lane because:

> Since applicants' claims requiring the use of a fluorine-containing gas, such as NF_3 or fluorocarbons like CF_4, still contain no significantly different processes (sic) limitations, the results of the [prior art] deposition must be considered to be inherently the same [as the claim result] especially for the CF_4 and because even minor levels of F contamination read on the claims.

52. The Examiner either found similarly with respect to the remaining prior art references or pointed to specific teachings of fluorine being included in the silicon oxide.

53. On February 12, 1996, Applicants filed an amendment responding to the Examiner's Final Office action.

54. As shown in Appendix 4 of this opinion, the amendment:

(1) amended claims 1 and 11; and

(2) cancelled claims 2, 3, 12, and 14.

Two new limitations in claims 1 and 11 being, a group of specific fluorocarbon gases (fluorine source) and a specific atomic percent of fluorine in the substrate.

55. After entry of the amendment, the application claims were 1, 5-11, 13, and 15.

56. In the amendment, Applicants stated as follows (emphasis added):

> The present claims are directed to a process for depositing silicon oxide films <u>containing at least 2.5 atomic percent of fluorine</u> from TEOS and a fluorocarbon.
>
> [Applicants go on to reargue that Lane does not produce a silicon oxide layer that contains fluorine whereas Applicants do, and to argue that Applicants' and Lane's processes have not been shown to be the same.]
>
> . . .
>
> [Similar arguments are made for Webb]
>
> . . .
>
> There is no disclosure [in Yu] of any fluorocarbons as additives to the plasma.
>
> . . .
>
> [A similar argument is made for Lory]
>
> . . .
>
> Otsubo et al does not obtain a fluorine-containing silicon oxide film.
>
> . . .

> In view of the above amendments and discussion, Applicants submit the present claims overcome the rejections and are patentable over the references.

57. On March 12, 1996, the Examiner entered a "Notice of Allowability" (the Notice) for the original application.

58. The Notice amends claim 5 as shown in Appendix 5 of this opinion.

59. The Notice also cited the following prior art:

(1) Nishiyama et al. (Nishiyama), U.S. Patent 5,429,995.

60. Nishiyama is prior art vis-à-vis Applicants under 35 U.S.C. § 102(e).

61. In the Notice, the Examiner indicates that Nishiyama is "art of interest, but not reading on the claims as now written" and that Nishiyama "teach[es] fluorinated silicon oxide plasma deposited films, but differ[s] in precursor materials."

62. Consistent with Office practice, the claims were re-numbered in the course of preparing the original application for issue, all as follows:

Chronological by original claim

Original claim number	Claim as re-numbered
1	1
2	Canceled
3	Canceled
4	Canceled
5	2
6	3
7	4
8	5
9	6
10	7

11	8
12	Canceled
13	9
14	Canceled
15	10

Chronological by patent claim

Original claim number	Claim as re-numbered
1	1
5	2
6	3
7	4
8	5
9	6
10	7
11	8
13	9
15	10
2	Canceled
3	Canceled
4	Canceled
12	Canceled
14	Canceled

63. On June 14, 1996, Applicants filed an amendment to claim 1 making consistency and editorial changes as shown in Appendix 5 of this opinion. The Examiner entered the amendment. However, the Examiner stated "the 'editorial' changes do change the scope of the claim, but not those aspects which were identified as patentably significant."

64. U.S. Patent 5,571,571 issued November 5, 1996, based on the original application and contained claims 1-10, all as shown in Appendix 6 of this opinion.

C. *Prosecution of reissue application*

65. Applicants filed reissue application 09/187,551 on November 5, 1998 seeking to reissue U.S. Patent 5,571,571.

66. Applicants presented original patent claims 1-10 along with new reissue application claims 11-26 for consideration, as shown in Appendix 7 of this opinion.

67. On July 16, 1999, the Examiner entered a First Non-final Office action.

68. Claims 1-26 were rejected on various grounds, not all of which are discussed *infra*.

69. Original patent claims 1-10 were rejected under 35 U.S.C. § 103 as being unpatentable over Nishiyama.

70. Reissue claims 11-26 were rejected under 35 U.S.C. § 251 as being improper recapture.

71. The Examiner found the following with respect to CF_4 in Example 1 of Nishiyama:

> It was noted in the reasons for allowance that Nishiyama et al was differentiated over by the allowed claims in PN. 5,571,571 because of the use of different precursor materials, however a closer reading of Example 1 . . . showed that the TEOS + 0_2+ NF_3 reactant gases [were] explicitly taught to have effective alternatives for the taught and claimed deposition, with CF_4, a claimed fluorocarbon

being specifically suggested as an alternative for NF_3, and various atomic % ranging from 2-5% suggested to be deposited dependant on flow rate. The more general teaching on col. 2, lines 53-54 also suggest NF_3, CF_4 and C_2F_6, alternately as other F-sources, hence it would have been abundantly obvious to one of ordinary skill in the art to substitute the claimed fluorocarbon compounds for NF_3 in the Nishiyama teaching to produce films by processes as claimed. Also note in col. 6, lines 12-25 of example 1, A1 wiring, ie (sic) spaced conductive lines, were formed on the substrate prior to the claimed and taught deposition. Any useful line width would have been expected to be used.

72. On December 22, 1999, Applicants filed an amendment responding to the Examiner's First Non-final Office action.

73. As shown in Appendix 8 of this opinion, the amendment:

(1) amended claims 1 and 8;

(2) cancelled claims 11-26; and

(3) added new claims 27-34.

74. The amendment to claims 1 and 8 narrowed the CX_4 limitation of each claim so as to remove CF_4 from the scope of claims 1 and 8.

75. On April 14, 2000, the Examiner entered a First Final Office action.

76. Claims 1-10 and 27-34 were rejected on various grounds not all of which are discussed *infra*.

77. Claims 1-10 and 27-34 were rejected under 35 U.S.C. § 103 as being unpatentable over Nishiyama.

78. Claims 27-34 were rejected under 35 U.S.C. § 103 as being unpatentable over Weise.

79. Claims 27, 28, 30, and 31 were rejected under 35 U.S.C. § 102, or alternatively 35 U.S.C. § 103, as being unpatentable over the following prior art:

(1) Homma (Homma-1), EP Application 0517548 A2; and

(2) Homma (Homma-2), U.S. Patent 5,288,518.

80. Homma-1 is prior art vis-à-vis Applicants under 35 U.S.C. § 102(b). Homma-2 is prior art vis-à-vis Applicants under 35 U.S.C. § 102(e).

81. Reissue claims 27-33 were rejected under 35 U.S.C. § 251 as being improper recapture.

82. Reissue claims 27-34 were rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement.

83. Reissue claims 27-33 were rejected under 35 U.S.C. § 251, as being based upon new matter.

84. On June 16, 2000, Applicants filed an amendment responding to the Examiner's First Non-final Office action.

85. As shown in Appendix 9 of this opinion, the amendment:

(1) cancelled claim 30; and

(2) amended claim 27 to incorporate the subject matter of claim 30 and to clarify that there is "another" plasma.

86. On October 31, 2000, the Examiner entered a Second Non-final Office action.

87. Claims 1-10, 27-29, and 31-34, were rejected on various grounds, not all of which are discussed *infra*.

88. Claims 1-10, 27-29, and 31-34 were rejected under 35 U.S.C. § 103 as being unpatentable over Nishiyama.

89. Claims 27-29 and 31-34 were rejected under 35 U.S.C. § 103 as being unpatentable over Weise.

90. Claims 27, 28, and 31 were rejected under 35 U.S.C. § 102, or alternatively 35 U.S.C. § 103, as being unpatentable over Homma-1 and Homma-2.

91. Reissue claims 27-29 and 31-33 were rejected under 35 U.S.C. § 251 as being improper recapture.

92. Reissue claims 27-29 and 31-34 were rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. In particular, a "tensile stress" is not supported in the original application.

93. Reissue claims 27-29 and 31-33 were rejected under 35 U.S.C. § 251, as being based upon new matter (same reasoning as the 35 U.S.C. § 112 rejection).

94. The Examiner found claims 27, 28, and 31 unpatentable over Homma-1 and Homma-2 because:

> Homma teaches the formation of fluorine-containing silicon oxide films where the internal stress is $2x10^8$ dynes/cm^2 (which is less than $4x10^8$) and the dielectric constant is about 3.7. Several methods of deposition are taught including plasma CVD via a parallel plate reactor and using reaction gases of O_2, TEOS and FSi $(OCH_2H_5)_3$, called fluorotriethyloxysilane, but could also be called triethylfluorosilicate, so abbreviation could be FTEOS, FTES or TEFS. Homma uses flow controller, bubblers and nitrogen gas to introduce the reactant gases into the reaction chamber, hence the flow rates are selected and controlled, so for the conditions used it is seen that the film properties produced are known, ie. (sic) predetermined.

See Figure 3 and col. 4, lines 8-57 in the EPO reference which is a statutory bar. The US Patent has like teachings, but is the (e) reference. Note the uncertainty over what applicants mean by their stress is the only reason for the 103 aspect of the rejection, and different measurement for different stresses would be expected to show correspondence.

95. The Examiner found claims 1-10, 27-29, and 31-34 unpatentable over Nishiyama because in part:

Nishiyama et a1 also teaches deposition of silicon oxide containing F, where plasma CVD, including duel frequency or high density plasma, are used (summary, esp. col. 2, lines 30-60 and col. 3, lines 31-56 and [line] 66-col. 4, line 6). Explicit teachings that [F] in the SiO_2 film "can be easily controlled by controlling the flow rate of the source gas" (col. 3, lines 53-56), with example 1 (col. 5-7) teaching reactant gases of TEOS + O_2+NF_3 where NF_3 flow rates of 50 sccm, 100 sccm, 150 sccm and 2005 (sic) sccm produced atomic % of about 2, 3, 4 and 5, respectively (col. 6. lines 36-50). Col. 7 provided alternate F-source teachings of CF_4, ClF_3, SiF_4 and $FSi(OCH_2H_5)_3$, and discussion of other reactant combinations also showing flow rate dependence (sic) for [F] deposited. As dopant concentration of fluorine in the silicon oxide deposit of Homma would have been expected to effect the stress level as discussed above, as well as the dielectric constant which Nishiyama also discusses, it would have been obvious to one of ordinary skill in the art that as flow rate of the F-sources has been shown by Nishiyama et al to be related to the amount of fluorine deposited, then controlling and adjusting flow rate in order to maintain or produce desired film properties dependent on the [F], such as the dielectric constant or the stress, would have been expected to be an effective and efficient way to produce consistent and desired results.

While Nishiyama et al does not include CF_3H or other fluorocarbon containing hydrogen in the non-exclusive list of other possible fluorine sources, these compounds are analogous or

homologous to the CF_4 explicitly taught, hence would have been obvious to one of ordinary skill in the art as useful alternatives, because they would have been expected to produce the same trend for [F]/stress effects, using routing experimentation to determine their desirable flow parameter, etc, No advantages were found in applicant's specification for using partially hydrogenated fluorocarbons and excluding perfluoronated (sic) ones, and all presented measurements used C_2F_6, now excluded from claims 1-10 or 33-34.

96A. The Examiner found that improper recapture was present in claims 27-29 and 31-33 because:

In order to make the claims allowable over the prior art in parent application 08/259,584, the specific halogen F, as well as the specific type of fluorine source, CX_4 and CX_3 - $(CX_2)_n$ - CX_3 were added to the claims, as well as the minimum concentration of F in the deposited silicon oxide.

96B. The Examiner also found that:

The new claims introduced in the reissue broaden the scope of the claims to include all types of halogens from any source and do not require a minimum [F].

96C. Lastly, the Examiner found that:

Furthermore, while the new claims, as exemplified by claims 27, relate the deposition of a layer deposited from gases comprising Si, O and halogen to "a desired stress" or "a tensile stress", this stress and the concentration of fluorine are inherently related, as can be seen in applicant's graphs (Figs 9-13) or in Homma (EPO 517,548 or USPN 5,288,578) in col. 4 of the EPO references, hence removing the concentration and source limitations is recapture. That applicant is stating an effect caused by the [F] previously claimed is essentially paraphrasing in order to broaden the claims, ie. (sic) recapture of previously excluded limitations or conditions.

97. The record supports the Examiner's findings with respect to what limitations do not appear in reissue application claim 27 which were present in claims 1 and 8 of the patent.

98. On March 5, 2001, Applicants filed an amendment responding to the Examiner's Second Non-final Office action.

99. As shown in Appendix 10 of this opinion, the amendment:

(1) amended claim 27 to clarify that it is the layer "with the desired tensile stress" in the "forming" step; and

(2) amended claim 33 to clarify that "the" tetraethylorthosilicate (TEOS) is the TEOS of claim 27.

100. On June 12, 2001, the Examiner entered a Second Final Office action.

101. The Second Final Office Action repeated the rejections of the Second Non-final Office Action.

102. On May 28, 2002, Applicants filed an Amended Appeal Brief (the Brief) fully replacing an Appeal Brief filed January 24, 2002.

103. Reissue application claims 1-10, 27-29, and 31-34, are before the Board in the appeal. A clean copy of claims on appeal appears in Appendix 11 of this opinion.

104. On October 25, 2002, the Examiner entered an Examiner's Answer (the Answer).

105. The Answer expands the reasoning for the rejection of reissue claims 27-29 and 31-34 under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement. The Answer also expands the reasoning for the

rejection of reissue claims 27-29 and 31-33 under 35 U.S.C. § 251, as being based upon new matter. Additionally, the Answer adds claim 34 to the rejection under 35 U.S.C. § 251, as being based upon new matter. [2]

106. For both rejections, the Examiner reasoned in part as follows (see Examiner's Answer entered October 25, 2002, pages 7-9):

(1) "there is no teaching that tensile stress . . . is more desirable than compressive stress";

(2) "nor does the specification compare layers deposited with or without halogens, as necessarily having tensile stress versus compressive stress";

(3) "all terms involving stress either have no modifier . . . or are compressive" [i.e., a "tensile stress" is not supported in the original application]; and

[2] There is some possibility on this record that Applicants might have presented an argument that the Examiner's reasoning at pages 7-9 of the Examiner's Answer, mailed October 25, 2002, is in effect a "new ground of rejection." It also might have been argued that such a new ground of rejection was not in compliance with the rules in effect at the time the Examiner's Answer was mailed. Additionally, there is some possibility on this record that Applicants might have argued that the Supplemental Examiner's Answer, mailed April 11, 2005, which revises the earlier answer (and the statement of the recapture rejection made in the earlier answer) was not in compliance with the rules in effect at the time it was mailed. See 37 CFR § 41.43(a)(2) (2005), which became effective on September 13, 2004. Notice of Final Rule, Practice Before the Board of Patent Appeals and Interferences, 69 Fed. Reg. 49660 (Aug. 12, 2004), reprinted in 1286 Off. Gaz. Pat. & Tm. Office 21 (Sep. 7, 2004). In the Reply Briefs, filed December 30, 2002 and June 13, 2005, Applicant did not make any of these arguments or note any procedural objection to the manner in which the Examiner procedurally presented the Examiner's position on appeal. Accordingly, Applicants has waived any procedural error which might have occurred in the manner in which the Examiner handled the appeal.

(4) "Fig. 13 only concerns C_2F_6, thus provides no evidence of tensile stress for any other compounds as claimed."

107. On December 30, 2002, Applicants filed a Reply Brief (the Reply).

108. On April 11, 2005, the Examiner entered a Supplemental Examiner's Answer (the Supplemental Answer) in response to a remand by this Board.

109A. The Supplemental Answer expands the reasoning for the rejection of reissue claims 27-29 and 31-33 under 35 U.S.C. § 251, based on improper recapture. (Supp. Ans. 7-12)

109B. The Examiner found that:

> In the original application for patent, the claims were rejected based on prior art prior resulting in the addition of:
> (1) the halogen source being fluorine,
> (2) the fluorine source being CX_4 or CX_3-$(CX_2)_n$-CX_3, and
> (3) the minimum fluorine concentration being 2.5 atomic percent.

(Supp. Ans. 8)

109C. The Examiner also found that:

> [I]n the original patent prosecution, to overcome the prior art rejection against the claims, the appellants rewrote the claims to add limitations (1) through (3).

(Supp. Ans. 8)

109D. The Examiner further found that:

> Additionally, appellant argued the limitations (1) through (3) as not being disclosed nor taught in the prior art of record, after which the claims were allowed.

(Supp. Ans. 8)

109E. The Examiner further found that:

> In the instant reissue application, claims 27-29 and 31-33 do not include the limitations of (1) through (3).

(Supp. Ans. 8)

110. The record supports the Examiner's findings with respect to what limitations do not appear in reissue application claim 27-29 and 31-33 which were present in claims 1 and 8 of the patent.

111. The Examiner determined:

> In the present instance, the reissue claims were either (a) not narrowed as compared with the surrendered claim subject matter, or (b) were narrowed, as compared with the surrendered claim subject matter only in areas not related to (not germane to) what was surrendered.

(Supp. Ans. 9)

112. On June 13, 2005, Applicant filed a Supplemental Reply Brief (the Supplemental Reply).

III. DISCUSSION – HOMMA BASED REJECTION

A. *The Examiner's prima facie case*

The Examiner's prima face case is set forth at Finding of Fact 94.

B. *Appellants' response to the Examiner's case*

Appellants argue at page 16 of the Brief, "Nothing in [Homma] discloses or suggests adding a flow of a halogen source to a selected process gas comprising tetraethylorthosilicate and oxygen to achieve a [desired] tensile stress, instead of a compressive stress in another layer formed using the selected process gas without the flow of the halogen source." We disagree.

First, we find that the claim language "instead of a compressive stress in another layer formed using the selected process gas without the flow of the halogen source" does not further limit the claimed process. Rather, it merely reiterated that the "desired tensile stress" is not a compressive stress in some other unclaimed process step. This already is a given from the recitation of a "desired tensile stress" in a layer with a halogen flow.

Second, Appellants admit at page 5 of the Reply that "Homma discloses that the addition [of] fluorine reduces the magnitude of the tensile stress from a strong tensile stress . . . to a weaker tensile stress for the fluorine-containing silicon oxide film." Thus Appellants agree with the Examiner on this point.

C. *Result*

The decision of the Examiner rejecting reissue claims 27-28 and 31 over Homma is affirmed.

IV. DISCUSSION – NISHIYAMA BASED REJECTION

A. *The Examiner's prima facie case*

The Examiner's prima face case is set forth at Findings of Fact 71 and 95.

B. *Appellants' response to the Examiner's case – Claims 1-10*

Appellants argue at page 9 of the Brief, "Nishiyama et al. discloses CF_4, ClF_3, SiF_4, and is devoid of any suggestion for the recited compounds [i.e., CY_4 and CX_3 - $(CX_2)_n$ - CX_3]." Appellants also argue, "[t]he rejection relies on hindsight" and Nishiyama "would not have motivated a person of ordinary skill in the art to develop the formula for fluorocarbon as recited in the claimed invention." We disagree.

As noted in Finding of Fact 71, the Examiner's rejection points out:

> The more general teaching on col. 2, lines 53-54 also suggest NF_3, CF_4 and C_2F_6, alternately as other F-sources, hence it would have been abundantly obvious to one of ordinary skill in the art to substitute the claimed fluorocarbon compounds for NF_3 in the Nishiyama teaching to produce films by processes as claimed.

We find that this teaching provides more than a sufficient reason to make the modification proposed by the Examiner without any resort to hindsight.

In addition, we note that Nishiyama's Example 7 explicitly teaches using C_2F_6 in place of NF_3 as proposed by the Examiner based on Nishiyama's Example 1.

C. *Appellants' response to the Examiner's case – Claims 27-29 and 31-34*

Appellants argue at page 16 of the Brief, "Nothing in [Nishiyama] discloses or suggests adding a flow of halogen source to a selected process gas comprising tetraethylorthosilicate and oxygen to achieve a [desired] tensile stress." We agree.

While we agree with the Examiner's position that some tensile stress value is inherent, we do not find that "a desired tensile stress" is inherent to the teachings of Nishiyama.

D. *Result*

The decision of the Examiner rejecting reissue claims 1-10 over Nishiyama is affirmed; and the decision of the Examiner rejecting reissue claims 27-29 and 31-34 over Nishiyama is reversed.

V. DISCUSSION – WEISE BASED REJECTION

A. *Appellants' response to the Examiner's case*

Appellants argue at page 16 of the Brief, "Nothing in [Weise] discloses or suggests adding a flow of halogen source to a selected process gas comprising tetraethylorthosilicate and oxygen to achieve a [desired] tensile stress." We agree. While we agree with the Examiner's position that some tensile stress value is inherent, we do not find that "a desired tensile stress" is inherent to the teachings of Weise.

B. *Result*

The decision of the Examiner rejecting reissue claims 27-29 and 31-34 over Weise is reversed.

VI. DISCUSSION – § 112, FIRST PARAGRAPH REJECTION

A. *The Examiner's prima facie case*

The Answer at pages 7-9 sets forth the Examiner's prima facie case (Finding of Fact 105). The Examiner bases the rejection on four points (Finding of Fact 106). The four points are: (1) there is no teaching that tensile stress . . . is more desirable than compressive stress; (2) nor does the Specification compare layers deposited with or without halogens, as necessarily having tensile stress versus compressive stress; (3) a "tensile stress" is not supported in the original application; and (4) Fig. 13 only concerns C_2F_6, thus provides no evidence of tensile stress for any other compounds as claimed.

B. *Appellants' response to the Examiner's case*

Appellants argue in the Brief (page 12) and Reply Briefs that the Declaration of Musaka filed on March 5, 2001, is sufficient to show that "tensile stress is clear to a person of ordinary skill in the art." We agree. Contrary to the Examiner's position, the Declaration is sufficient to rebut the Examiner's third point.

However, we find no attempt by Appellants in the record of this appeal (e.g., the Reply Briefs) to rebut Examiner's first, second, and fourth points. These points stand unchallenged by Appellants.

C. *Result*

The decision of the Examiner rejecting reissue claims 27-29 and 31-34 under 35 U.S.C. § 112, first paragraph, is affirmed.

VII. DISCUSSION – NEW MATTER REJECTION

A. *The Examiner's prima facie case*

The Answer at pages 7-9 sets forth the Examiner's prima facie case (Finding of Fact 105). The Examiner bases the rejection on four points (Finding of Fact 106). The four points are: (1) there is no teaching that tensile stress . . . is more desirable than compressive stress; (2) nor does the Specification compare layers deposited with or without halogens, as necessarily having tensile stress versus compressive stress; (3) a "tensile stress" is not supported in the original application; and (4) Fig. 13 only concerns C_2F_6, thus provides no evidence of tensile stress for any other compounds as claimed.

B. *Appellants' response to the Examiner's case*

Appellants argue in the Brief (page 12) and Reply Briefs that the Declaration of Musaka filed on March 5, 2001, is sufficient to show that "tensile stress is clear to a person of ordinary skill in the art." We agree. Contrary to the Examiner's position, the Declaration is sufficient to rebut the Examiner's third point.

However, we find no attempt by Appellants in the Reply Briefs to rebut Examiner's first, second, and fourth points. These points stand unchallenged by Appellants.

C. *Result*

The decision of the Examiner rejecting reissue claims 27-29 and 31-34 under 35 U.S.C. § 251 based upon new matter is affirmed.

VIII. DISCUSSION – RECAPTURE REJECTION

A. *Recapture Principles*

(1)
The statute

The reissue statute expressly permits a patentee to correct an error thus permitting patentee to obtain reissue claims broader than the originally issued patent claims at any time within two (2) years from the date the original patent issues. More particularly, 35 U.S.C. § 251, ¶¶ 1 and 4, provide in pertinent part:

> Whenever any patent is, through error without any deceptive intention, deemed wholly or partly inoperative or invalid, by reason of a defective specification or drawing, or by reason of the patentee claiming more or less than he had a right to claim in the patent, the Director shall, on the surrender of such patent and the payment of the fee required by law, reissue the patent for the invention disclosed in the original patent, and in accordance with a new and amended application, for the unexpired part of the term of the original patent.
>
> No reissued patent shall be granted enlarging the scope of the claims of the original patent unless applied for within two years from the grant of the original patent.

(2)
Recapture is not an error within the meaning of 35 U.S.C. § 251

What has become known as the "recapture rule," prevents a patentee from regaining through a reissue patent subject matter that the patentee surrendered in an effort to obtain allowance of claims in the patent sought to be reissued. *In re Clement,* 131 F.3d 1464, 1468 (Fed. Cir. 1997).

If a patentee attempts to "recapture" what the patentee previously surrendered in order to obtain allowance of original patent claims, that "deliberate withdrawal or amendment ... cannot be said to involve the inadvertence or mistake contemplated by 35 U.S.C. § 251, and is not an error of the kind which will justify the granting of a reissue patent which includes the [subject] matter withdrawn." *Mentor Corp. v. Coloplast, Inc.*, 998 F.2d 992, 995 (Fed. Cir. 1993), quoting from *Haliczer v. United States*, 356 F.2d 541, 545 (Ct. Cl. 1966).[3] *See also Hester Industries Inc. v. Stein, Inc.*, 142 F.3d 1472, 1480 (Fed. Cir. 1998).

(3)
In re Clement

The Federal Circuit's opinion in *Clement* discusses a three-step test for analyzing recapture.

Step 1 involves a determination of whether and in what aspect any claims sought to be reissued are broader than the patent claims. The Federal Circuit reasoned that a reissue application claim deleting a limitation or element from a patent claim is broader as to that limitation's or element's aspect. 131 F.3d at 1468.

Step 2 involves a determination of whether the broader aspects of the reissue application claims relate to surrendered subject matter. 131 F.3d at 1468-69. In this respect, review of arguments and/or amendments during the prosecution

[3] *Haliczer* is binding precedent. *See South Corp. v. United States*, 690 F.2d 1368 (Fed. Cir. 1982) (in banc) (decisions of the former U.S. Court of Customs and Patent Appeals and former U.S. Court of Claims decisions are binding precedent).

history of the application, which matured into the patent sought to be reissued, is appropriate. In reviewing the prosecution history, the Federal Circuit observed that "[d]eliberately canceling or amending a claim in an effort to overcome a [prior art] reference strongly suggests that the Applicant admits that the scope of the claim before cancellation or amendment is unpatentable." 131 F.3d at 1469.

Step 3 is applied when the broadening relates to surrendered subject matter and involves a determination whether the surrendered subject matter has crept into the reissue application claim. *Id.* The following principles were articulated in *Clement*, 131 F.3d at 1469-70:

> *Substep* (1): if the reissue claim is as broad as or broader than the canceled or amended claim in all aspects, the recapture rule bars the claim;
>
> *Substep* (2): if it is narrower in all aspects, the recapture rules does not apply, but other rejections are possible;
>
> *Substep* (3): if the reissue claim is broader in some aspects, but narrower in others, then:
>
> (a) if the reissue claim is as broad as or broader in an aspect germane to a prior art rejection, but narrower in another aspect completely unrelated to the rejection, the recapture rule bars the claim;
>
> (b) if the reissue claim is narrower in an aspect germane to [a] prior art rejection, and broader in an aspect unrelated to the rejection, the recapture rule does not bar the claim, but other rejections are possible.

(4)
North American Container

In *North American Container, Inc. v. Plastipak Packaging, Inc.*, 415 F.3d 1335 (Fed. Cir. 2005), the Federal Circuit had occasion to further address Substep (3)(a) of *Clement*.

North American Container involved a reissue patent, which had been held invalid by the U.S. District Court for the Northern District of Texas. The district court bottomed its invalidity holding based on a violation of the recapture rule. During prosecution of an application for patent, an examiner rejected the claims over a combination of two prior art references: Dechenne and Jakobsen. To overcome the rejection, *North American Container* limited its application claims by specifying that a shape of "inner walls" of a base of a container was "generally convex." *North American Container* convinced the examiner that the shape of the base, as amended, defined over "both the Dechenne patent, wherein the corresponding wall portions 3 are *slightly concave* ... and the Jakobsen patent, wherein the entire reentrant portion is clearly *concave in its entirety*." 415 F.3d at 1340. After a patent issued containing the amended claims, *North American Container* filed a reissue application seeking reissue claims in which (1) the language "inner wall portions are generally convex" was eliminated, but (2) the language "wherein the diameter of said re-entrant portion is in the range of 5% to 30% of the overall diameter of said side wall" was added. Thus, the claim sought be reissued was broader in some aspects and narrower in other aspects.

The Federal Circuit, applying the *Clement* three-step test, held that the reissue claims were broader in scope than the originally-issued claims in that they no longer require the "inner walls" to be "generally convex." The Federal Circuit further found that the broadened aspect (i.e., the broadened limitation) "relate[d] to subject matter that was surrendered during prosecution of the original-filed claims." 415 F.3d at 1350. The Federal Circuit observed "the reissue claims were not narrowed with respect to the 'inner wall' limitation, thus avoiding the recapture rule." The Federal Circuit stated:

> [t]hat the reissue claims, looked at as a whole, may be of "intermediate scope" is irrelevant. . . . [T]he recapture rule is applied on a limitation-by-limitation basis, and ... [North American Container's] deletion of the "generally convex" limitation clearly broadened the "inner wall" limitation.

Id. Thus, the Federal Circuit in *North American Container* further refined Substep (3)(a) of *Clement:* "broader in an aspect germane to a prior art rejection" means broader with respect to a *specific* limitation (1) added to overcome prior art in prosecution of the application which matured into the patent sought to be reissued and (2) eliminated in the reissue application claims.

(5)
Ex parte Eggert

The opinion in *Ex parte Eggert*, 67 USPQ2d 1716 (BPAI 2003), issued as a precedential opinion, is also part of the recapture precedent applicable to proceedings before the United States Patent & Trademark Office (USPTO). *Eggert* was entered on May 29, 2003, prior to the Federal Circuit's *North*

American Container decision. In *Eggert*, a majority stated that "[i]n our view, the surrendered subject matter is the outer circle of Drawing 1 [the rejected claim prior to the amendment that resulted in the claim being issued] because it is the subject matter appellant conceded was unpatentable." 67 USPQ2d at 1717. The majority further held that "in our view" subject matter narrower than the rejected claim but broader than the patented claim is not barred by the recapture rule. *Id.* The majority explained that if the finally rejected claim was ABC and the patent claim was ABCDEF, there would be recapture for ABC or anything broader than ABC, but not for claims directed to ABCX, $ABCD_{Br}$, ABCEF, or $A_{Br}BCDEF$, because those claims would be narrower than the finally rejected claim ABC. 67 USPQ2d at 1718. In its opinion, the majority recognized that the Federal Circuit had held that "the mere presence of narrowing limitations in the reissue claim is not necessarily sufficient to save the reissue claim from the recapture rule." 67 USPQ at 1729.

Board of Patent Appeals and Interferences Standard Operating Procedure 2 (Revision 6) (August 10, 2005) mandates that a published precedential opinion of the Board is binding on all judges of the Board *unless* the views expressed in an opinion in support of the decision, among a number of things, are inconsistent with a decision of the Federal Circuit. In our view, the majority view in *Eggert* is believed to be inconsistent with the subsequent Federal Circuit decision in *North American Container* with respect to the principles governing application of Substep (3)(a) of *Clement*.

The *Eggert* majority's analysis is believed to be consistent with *North American Container* in that the majority applied the three-step framework analysis set forth in applicable Federal Circuit opinions, *e.g.*, (1) *Pannu v. Storz Instruments, Inc.*, 258 F.3d 1366, 1370-71 (Fed. Cir. 2001); (2) *Clement,* 131 F.3d at 1470; and (3) *Hester*, 142 F.3d at 148. However, the *Eggert* majority also held that the surrendered subject matter was the rejected claim only rather than the amended portion of the issued claim. 67 USPQ2d at 1717. At a similar point in the recapture analysis, *North American Container* has clarified the application of the three-step framework analysis. *North American Container* holds that the "inner walls" limitation (a portion of the issued claim that was added to the rejected claim by amendment) was "subject matter that was surrendered during prosecution of the original-filed claims." 415 F.3d at 1350.

It is believed that the Substep (3)(a) rationale of the *Eggert* majority (1) is not consistent with the rationale of the Federal Circuit in *North American Container* and (2) should no longer be followed or be applicable to proceedings before the USPTO.

(6)
What subject matter is surrendered?

In a case involving Substep (3)(a) of Step 3 of *Clement*, what is the subject matter surrendered?

Is it

(1) the subject matter of an application claim which was amended or canceled or

(2) the subject matter of an application claim which was amended or canceled *and*, on a limitation-by-limitation basis, the territory falling between the scope of

(a) the application claim which was canceled or amended and

(b) the patent claim which was ultimately issued?

We believe *North American Container* stands for the proposition that it is (2) and not (1). Accordingly, we hold that it is (2).

(7)
Clement principles are not per se rules

Our reading of our appellate reviewing court's recapture opinions, as a whole, suggests that the *Clement* steps should not be viewed as per se rules. For example, we note the following in *Clement*, 131 F.3d at 1469:

> Although the recapture rule does not apply in the absence of evidence that the Appellant's amendment was "an admission that the scope of that claim was not in fact patentable," *Seattle Box Co. v. Industrial*

> *Crating & Packing, Inc.*, 731 F.2d 818, 826 (Fed. Cir. 1984), "the court may draw inferences from changes in claim scope when other reliable evidence of the patentee's intent is not available," *Ball [Corp. v. United States]*, 729 F.2d at 1436. Deliberately canceling or amending a claim in an effort to overcome a reference strongly suggests that the Appellant admits that the scope of the claim before the cancellation or amendment is unpatentable, but it is not dispositive because other evidence in the prosecution history may indicate the contrary. *See Mentor [Corp. v. Coloplast, Inc.]*, 998 F.2d at 995-96; *Ball*, 729 F.2d at 1438; *Seattle Box Co.*, 731 F.2d at 826 (declining to apply the recapture rule in the absence of evidence that the Appellant's "amendment ... was in any sense an admission that the scope of [the] claim was not patentable"); *Haliczer [v. United States]*, 356 F.2d at 545 (acquiescence in the rejection and acceptance of a patent whose claims include the limitation added by the Appellant to distinguish the claims from the prior art shows intentional withdrawal of subject matter); *In re Willingham*, 282 F.2d 353, 354, 357 (CCPA 1960) (no intent to surrender where the Appellant canceled and replaced a claim without an intervening action by the examiner). Amending a claim "by the inclusion of an additional limitation [has] exactly the same effect as if the claim as originally presented had been canceled and replaced by a new claim including that limitation." *In re Byers*, 230 F.2d 451 (CCPA 1956). [Footnote and citations to the USPQ and CCPA reports omitted.]

(8)
Allocation of burden of proof

What is the proper allocation of the burden of proof in ex parte examination?

For reasons that follow, we hold that an Examiner has the burden of making out a prima facie case of recapture. The Examiner can make out a prima facie case of recapture by establishing that the claims sought to be reissued fall within Substeps (1) or 3(a) of Step 3 of *Clement*.

For reasons that follow, we also hold that once a prima facie case of recapture is established, the burden of persuasion then shifts to the Appellants to establish that the *prosecution history* of the application, which matured into the patent sought to be reissued, establishes that a surrender of subject matter did not occur (or that the reissue claims are materially narrowed).

As will become apparent, our rationale parallels the practice in determining whether subject matter is surrendered when a doctrine of equivalents analysis occurs in infringement cases.

(9)
Burden of proof analysis

Our analysis begins with an observation made by our appellate reviewing court in *Hester*, 142 F.3d at 1481-82:

> [A]s recognized in *Ball*, the recapture rule is based on principles of equity[4] and therefore embodies the notion of estoppel. 729 F.2d at 1439. Indeed, the recapture rule is quite similar to prosecution history estoppel, which prevents the application of the doctrine of equivalents in a manner contrary to the patent's prosecution history. *See Warner-Jenkinson Co. v. Hilton Davis Chem. Co.*, [520 U.S. 17, 33,] 117 S. Ct. 1040, 1051 (1997). Like the recapture rule, prosecution history estoppel prevents a patentee from regaining subject matter surrendered during prosecution in support of patentability. *See id.*

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[4] The reissue statute has been characterized as being remedial in nature, based on fundamental principles of equity and fairness and should be construed liberally. *In re Bennett*, 766 F.2d 524, 528 (Fed. Cir. 1985) (in banc); *In re Willingham*, 282 F.2d 353, 354-55 (CCPA 1960). Nevertheless, fairness to the public must also be considered. As stated in *Mentor*, "the reissue statement cannot be construed in such a way that competitors, properly relying on prosecution history, become patent infringers when they do so." 998 F.2d at 996.

> *Hester* argues that an analogy cannot be made with prosecution history estoppel because the reissue procedure and prosecution history estoppel are the antithesis of one another--reissue allows an expansion of patent rights whereas prosecution history estoppel is limiting. However, Hester's argument is unpersuasive. The analogy is not to the broadening aspect of reissue. Rather, the analogy is with the recapture rule, which restricts the permissible range of expansion through reissue just as prosecution history estoppel restricts the permissible range of equivalents under the doctrine of equivalents.
>
> This court earlier concluded that prosecution history estoppel can arise by way of unmistakable assertions made to the Patent Office in support of patentability, just as it can arise by way of amendments to avoid prior art. *See, e.g., Texas Instruments, Inc. v. International Trade Comm'n*, 988 F.2d 1165, 1174 (Fed. Cir. 1993). [citations to the USPQ reports omitted.]

See also Judge Michel's opinion concurring-in-part and dissenting-in-part in *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., Ltd.*, 234 F.3d 558, 602 (Fed. Cir. 2000) (Festo I), *vacated and remanded*, 535 U.S. 722, 122 S. Ct. 1831 (2002) (Festo II)[5] (Michel, J.,):

> [T]he law of prosecution history estoppel has developed with equal applicability to reissue patents and original patents whose claims were amended during prosecution. By at least 1879, the Supreme Court recognized that the process of obtaining a reissue patent precluded the patentee from recapturing that which he had disclaimed (i.e., surrendered), through the reissuance process.

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[5] The "Festo" convention used in this opinion is:
Festo I is the original in banc decision of the Federal Circuit.
Festo II is the decision of the Supreme Court.
Festo III is the decision of the Federal Circuit on remand.

(10)
Relevance of prosecution history

"Surrendered subject matter" is defined in connection with prosecution history estoppel in *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., Ltd.*, 535 U.S. 722, 733-34, 122 S. Ct. 1831, 1838 (2002) (Festo II):

> The doctrine of equivalents allows the patentee to claim those insubstantial alterations that were not captured in drafting the original patent claim but which could be created through trivial changes. When, however, the patentee originally claimed the subject matter alleged to infringe but then narrowed the claim in response to a rejection, he may not argue that the surrendered territory comprised unforeseen subject matter that should be deemed equivalent to the literal claims of the issued patent. On the contrary, "[b]y the amendment [the patentee] recognized and emphasized the difference between the two phrases[,] ... and [t]he difference which [the patentee] thus disclaimed must be regarded as material." *Exhibit Supply Co. v. Ace Patents Corp.*, 315 U.S. 126, 136-37, 62 S. Ct. 513, 518-19 (1942).

Festo II goes on to comment, 535 U.S. at 737-41, 122 S. Ct. at 1840-42:

> [Prosecution history estoppel's] reach requires an examination of the subject matter surrendered by the narrowing amendment. [A] complete bar [would avoid] this inquiry by establishing a per se rule; but that approach is inconsistent with the purpose of applying the estoppel in the first place-to hold the inventor to the representations made during the application process and to the inferences that *may reasonably* be drawn from the amendment (emphasis added).
>
> ***
>
> A patentee's decision to narrow his claims through amendment *may be presumed to be a general disclaimer of the territory between the original claim and the amended claim. Exhibit Supply*, 315 U.S., at 136-137, 62 S. Ct. 513 ("By the amendment [the patentee] recognized

> and emphasized the difference between the two phrases and proclaimed his abandonment of all that is embraced in that difference"). There are some cases, however, where the amendment *cannot reasonably be viewed as surrendering* a particular equivalent. The equivalent may have been unforeseeable at the time of the application; the rationale underlying the amendment may bear no more than a tangential relation to the equivalent in question; or there may be some other reason suggesting that the patentee could not reasonably be expected to have described the insubstantial substitute in question. In those cases *the patentee can overcome the presumption* that prosecution history estoppel bars a finding of equivalence (emphasis added).
>
> ***
>
> When the patentee has chosen to narrow a claim, *courts may presume* the amended text was composed with awareness of this rule and that the territory surrendered is not an equivalent of the territory claimed. In those instances, however, *the patentee still might rebut the presumption* that estoppel bars a claim of equivalence. The patentee must show that at the time of the amendment one skilled in the art *could not reasonably* be expected to have drafted a claim that would have literally encompassed the alleged equivalent (emphasis added).

The same policy considerations that prevent a patentee from urging equivalents within what the Supreme Court refers to as "surrendered territory" should prima facie prohibit the patentee from being able to claim subject matter within the surrendered territory in reissue. Accordingly, the "surrendered subject matter" that may not be recaptured through reissue should be *presumed* to include subject matter broader than the patent claims in a manner directly related to (1) limitations added to the claims by amendment (either by amending an existing claim or canceling a claim and replacing it with a new claim with that limitation) to

overcome a patentability rejection and (2) limitations argued to overcome a patentability rejection without amendment of a claim. These presumptions are believed to place practical and workable burdens on Examiners and Appellants.

(11)
Admissible evidence in rebuttal showing

As in the case of surrender when applying the doctrine of equivalents, reissue Appellants should have an opportunity to rebut any prima facie case made by an Examiner.

What evidence may Appellants rely on to rebut any prima facie case of recapture?

We hold that the admissible rebuttal evidence generally should be limited to (1) the prosecution history of the application which matured into the patent sought to be reissued and (2) showings related to what was known by a person having ordinary skill in the art at the time an amendment was made. Nevertheless, we will not attempt to divine, at this time, all evidence that might be relevant. As with other issues that come before the USPTO, such as obviousness and enablement, the evidence to be presented will vary on a case-by-case basis, as will the analysis of that evidence.

"It is clear that in determining whether 'surrender' of subject matter has occurred, the proper inquiry is whether an objective observer viewing the prosecution history would conclude that the purpose of the patentee's amendment or argument was to overcome prior art and secure the patent." *Kim v. ConAgra*

Foods, Inc., 465 F.3d 1312, 1323 (Fed. Cir. 2006). Thus, we also hold that Appellants must show that at the time the amendment was made, an "objective observer" could not reasonably have viewed the subject matter broader than any narrowing amendment as having been surrendered (or that an "objective observer" would view the reissue claims as materially narrowed). The showing, required to be made by Appellants, is consistent with the public notice function of claims. Nevertheless, some limited extrinsic evidence may be relevant. However, extrinsic evidence unavailable to an "objective observer" at the time of the amendment is not relevant to showing that an "objective observer" could not reasonably have viewed the subject matter as having been surrendered. Limiting the nature of the admissible evidence is believed to be consistent with the Federal Circuit's decision on remand following Festo II. *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co., Ltd.*, 344 F.3d 1359, 1367 (Fed. Cir. 2003), *cert. denied*, 541 U.S. 988 (2004) (Festo III).

On remand, the Federal Circuit notes (*Id.* at 1367-70):

> [W]e reinstate our earlier holding that a patentee's rebuttal of the *Warner-Jenkinson* presumption is restricted to the evidence in the prosecution history record. *Festo* [I], 234 F.3d at 586 & n.6; *see also Pioneer Magnetics*, 330 F.3d at 1356 (stating that only the prosecution history record may be considered in determining whether a patentee has overcome the *Warner-Jenkinson* presumption, so as not to undermine the public notice function served by that record). If the patentee successfully establishes that the amendment was not for a reason of patentability, then prosecution history estoppel does not apply.

***

> . . . By its very nature, objective unforeseeability depends on underlying factual issues relating to, for example, the state of the art and the understanding of a hypothetical person of ordinary skill in the art at the time of the amendment. Therefore, in determining whether an alleged equivalent would have been unforeseeable, a district court may hear expert testimony and consider other extrinsic evidence relating to the relevant factual inquiries.
>
> . . . As we have held in the *Warner-Jenkinson* context, that reason should be discernible from the prosecution history record, if the public notice function of a patent and its prosecution history is to have significance. *See id.* at 1356 ("Only the public record of the patent prosecution, the prosecution history, can be a basis for [the reason for the amendment to the claim]. Otherwise, the public notice function of the patent record would be undermined."); Festo [I], 234 F.3d at 586 ("In order to give due deference to public notice considerations under the *Warner-Jenkinson* framework, a patent holder seeking to establish the reason for an amendment must base his arguments solely upon the public record of the patent's prosecution, i.e., the patent's prosecution history. To hold otherwise--that is, to allow a patent holder to rely on evidence not in the public record to establish a reason for an amendment--would undermine the public notice function of the patent record."). Moreover, whether an amendment was merely tangential to an alleged equivalent necessarily requires focus on the context in which the amendment was made; hence the resort to the prosecution history. Thus, whether the patentee has established a merely tangential reason for a narrowing amendment is for the court to determine from the prosecution history record without the introduction of additional evidence, except, when necessary, testimony from those skilled in the art as to the interpretation of that record.
>
> . . . When at all possible, determination of the third rebuttal criterion should also be limited to the prosecution history record. . . . We need not decide now what evidence outside the prosecution history record, if any, should be considered in determining if a patentee has met its burden under this third rebuttal criterion.

We interpret Festo III to generally, perhaps effectively, limit the admissible rebuttal evidence to the prosecution history record and extrinsic evidence related to the knowledge of the hypothetical person of ordinary skill in the art at the time of the amendment. Admitting evidence not available to the public, such as an affidavit of an attorney giving mental impressions from the attorney who made the amendment, would undermine the public notice function of the patent and its prosecution history.

(12)
Materially Narrowed in Overlooked Aspects

When reissue claims are narrower than the patent claims with respect to features other than the surrender generating feature, then the reissue claims may be materially narrowed relative to the claims prosecuted and issued in the patent, thereby avoiding the recapture rule.

The Federal Circuit in *North American Container* characterized the second and third steps in applying the recapture rule as determining "whether the broader aspects of the reissue claims relate to subject matter surrendered in the original prosecution" and "whether the reissued claims were materially narrowed in other respects, so that the claims may not have been enlarged, and hence avoid the recapture rule." 415 F.3d at 1349 (emphases added), citing for authority *Pannu*, 258 F.3d at 1371. The language "materially narrowed in other respects" relates for comparison back to the earlier recited "broader aspects of the reissued claims" (i.e., surrendered subject matter). Thus, by using the phrase "in other respects" to

modify "materially narrowed," the court makes clear that reissue claims will avoid the recapture rule if materially narrowed in respects other than the broader aspects relating to surrendered subject matter. This plain language in *North American Container* indicates that the recapture rule is avoided if the added limitations are a materially narrowing in respects other than the broader aspects relating to surrendered subject matter.

In *Pannu*, the Federal Circuit described the second step of the recapture rule analysis as determining "whether the broader aspects of the reissued claim related to surrendered subject matter." 258 F.3d at 1371 (quoting *Clement,* 131 F.3d at 1468). With regard to the third step, the court stated: "Finally, the Court must determine whether the reissued claims were materially narrowed in other respects to avoid the recapture rule." *Id.* (emphases added), citing for authority *Hester*, 142 F.3d at 1482-83; *Clement*, 131 F.3d at 1470. As in *North American Container*, the language "materially narrowed in other respects" relates for comparison back to the earlier recited "broader aspects of the reissued claim" (i.e., surrendered subject matter). Again, modification of "materially narrowed" with the phrase "in other respects" clarifies that reissue claims will avoid the recapture rule if materially narrowed in respects other than the broader aspects relating to surrendered subject matter.

Similarly, in *Hester Indus.,* the Federal Circuit determined that "surrendered subject matter - i.e., cooking other than solely with steam and with at least two sources of steam – has crept into the reissue claims [because] [t]he asserted reissue claims are unmistakably broader in these respects." 142 F.3d at 1482.

Immediately after making this determination, the court then stated: "Finally, because the recapture rule may be avoided in some circumstances, we consider whether the reissue claims were materially narrowed in other respects." *Id.* (emphases added). Yet again, the language "materially narrowed in other respects" relates for comparison back to the earlier recited language "[t]he asserted reissue claims are unmistakably broader in these respects." It follows that *Hester Indus.* also makes clear that a reissue claim will avoid the recapture rule if materially narrowed in respects other than the broader aspects relating to surrendered subject matter.

There is a reason the Federal Circuit has repeatedly assessed recapture rule avoidance in terms of whether the reissue claims were materially narrowed in respects other than the broader aspects relating to surrendered subject matter. The reason involves the purpose served by permitting the recapture rule to be avoided under certain circumstances. This purpose is described in *Hester Indus.* as follows:

> [T]his principle [i.e., avoidance of the recapture rule], in appropriate cases, may operate to overcome the recapture rule when the reissue claims are materially narrower in other overlooked aspects of the invention. The purpose of this exception to the recapture rule is to allow the patentee to obtain through reissue a scope of protection to which he is rightfully entitled for such overlooked aspects.

142 F.3d at 1482-83.

As explained in *Hester Indus.*, the recapture rule is avoided when two conditions are satisfied. First, an aspect of the invention must have been overlooked (e.g., not claimed) during patent prosecution. Second, the reissue claim must have been materially narrowed with respect to this overlooked aspect

of the invention. Because recapture rule avoidance requires the reissue claim to be materially narrowed in an overlooked aspect of the invention, this material narrowing must be in respects other than the broader aspects relating to surrendered subject matter. Stated differently, a material narrowing in an overlooked aspect cannot possibly relate to surrendered subject matter since this subject matter, having been claimed and then surrendered during original prosecution, could not have been overlooked.

In *Pannu*, the Federal Circuit stated that "[t]he narrowing aspect of the claim on reissue … was not related to the shape of the haptics, but rather the positioning and dimensions of the snag resistant means [, and] [t]herefore, the reissued claims were not narrowed in any material respect compared to their broadening." 258 F.3d at 1372. If read in a vacuum, this statement might appear to support a contrary result to our analysis. However, the court's opinion in general and this statement in particular must be read, not in a vacuum but, in light of the facts of the case on appeal.

The reissued claim in *Pannu* was narrowed by requiring the snag resistant means to be "at least three times greater" than the width of the haptics and by requiring the snag resistant means to be "substantially coplanar" with the haptics. 258 F.3d at 1372. As revealed in the underlying District Court decision, these same or similar limitations were present in claims throughout prosecution of the original patent application. *Pannu v. Storz Instruments, Inc.*, 106 F. Supp. 2d 1304, 1308 (S.D Fla. 2000). For this reason, the District Court held that the recapture rule had not been avoided because the narrowing limitations were not

overlooked aspects of the invention and did not materially narrow the claim. *Id.,* 106 F. Supp 2d at 1308-09, citing for authority *Hester Indus.,* 142 F.3d at 1483 and *Clement*, 131 F.3d at 1469.

This factual background more fully illuminates the Federal Circuit's determination in *Pannu* that the reissued claims were not narrowed in any material respect compared with their broadening. This determination is not based on the fact that the narrowing limitations of the reissue claims were unrelated to their broadening. Rather, it is based on the fact that these same or similar limitations had been prosecuted in the original patent application and therefore were not overlooked aspects of the invention and did not materially narrow the reissue claims.

The reissue claims in *Clement* were both broader and narrower in aspects germane to a prior art rejection. 131 F.3d at 1470. However, the narrower limitation recited in the *Clement* reissue claims ("at least 59 ISO in the final pulp"; *see* clause (e) of reissue claim 49) also was recited in the patent claims (*see* clause (f) of patent claim 1). 131 F.3d at 1470, 1474. Therefore, the narrowing limitation of *Clement*, like *Pannu*, was not overlooked during original prosecution and did not materially narrow the reissue claim.

Additionally, in setting forth the test for recapture *Clement* states in part that "if the reissue claim is narrower in an aspect germane to prior art rejection, and broader in an aspect unrelated to the rejection, the recapture rule does not bar the claim" and specifically states that "*Ball* is an example of (3)(b)." 131 F.3d at 1470. The claims before the court in *Ball* were determined by the trial judge to be

materially narrower as to a feature not found in the originally prosecuted claims and were determined by the Examiner to distinguish over the prior art. See *Ball Corporation v. The United States*, 219 USPQ 73, 79 (Cl. Ct. 1982). ("[T]he new reissue claims recite structure never before recited in any claim presented during the prosecution of the original case. These recitations appear, on their face, to be substantial.")

Finally, in *Mentor*, each of the limitations added to the reissue claims were thoroughly analyzed and determined to not be materially narrowing because the same or similar features were in the patent claims or the prior art. *Mentor*, 998 F.2d at 996. It follows that the reissue claims of *Mentor*, like those of *Pannu* and *Clement*, failed to avoid the recapture rule because they had been broadened to include surrendered subject matter but had not been narrowed in any material respect.

In summary, the recapture rule is avoided if the reissue claim was materially narrowed in other respects compared to its broadening surrendered aspect. A reissue claim is materially narrowed and thus avoids the recapture rule when limited to aspects of the invention:

(1) which had not been claimed and thus were overlooked[6] during prosecution of the original patent application;[7] and

[6] This presumes that the aspects were in-fact present during prosecution so as to be overlooked, i.e., the reissue claims find support in the patent prosecution so as to comply with the conditions of 35 U.S.C. § 112, first paragraph.

[7] For a patent containing only apparatus claims, it might be argued that reissue method claims cannot involve surrendered subject matter where no method claim was ever presented during prosecution of the patent. However, surrender is not

(2) which patentably distinguish over the prior art.

(13)
Non-relevance of "intervening rights"

We have not overlooked a possibility that an argument might be made that the so-called intervening rights provision relating to reissues makes jurisprudence on the doctrine of equivalents presumption inapplicable to reissue recapture rules. Our answer as to the argument is similar to the answer given by the Federal Circuit in *Hester* with respect to whether the doctrine of equivalents surrender principles have any applicability to reissue surrender principles. *Hester* squarely held that they do. Moreover, mixing "intervening rights" with "surrender" is like mixing apples with oranges or putting the cart before the horse. A patentee seeking a reissue claim which is barred by recapture is not entitled to a reissue patent under 35 U.S.C. § 251. If there is no reissue patent, there can be no intervening rights.

(14)
Public Notice

We believe that any recapture analysis must be bottomed principally on a "public notice" analysis which can occur only after a record becomes "fixed." In the case of a patent, the "claims" and the "prosecution history" become fixed at the time the patent is issued--not during "fluid" patent prosecution where claims and arguments can change depending on the circumstances, *e.g.*, prior art applied and

avoided merely by categorizing a claimed invention as a method rather than an apparatus. It is the scope of a claimed invention, not its categorization, which determines whether surrendered subject matter has crept into a reissue claim.

amendments to claims. It is from a fixed perspective that the public (not the patentee) must make an analysis of what the patentee surrendered during prosecution. Moreover, Appellants (not the public) control what amendments and arguments are presented during prosecution. When an amendment or argument is presented, it is Appellants that should be in the best position to analyze what subject matter (i.e., territory to use the Supreme Court's language) is being surrendered (or explain why the reissue claims are materially narrowed).

Our belief is supported by what appears to be dicta in *MBO Laboratories, Inc. v. Becton, Dickinson & Company*, 474 F.3d 1323, 1331-32 (Fed. Cir. 2007):

> The recapture rule is a limitation on the ability of patentees to broaden their patents after issuance. . . . . Section 251 is "remedial in nature, based on fundamental principles of equity and fairness, and should be construed liberally." However, the remedial function of the statute is limited. Material which has been surrendered in order to obtain issuance cannot be reclaimed via Section 251: . . . It is critical to avoid allowing surrendered matter to creep back into the issued patent, since competitors and the public are on notice of the surrender and may have come to rely on the consequent limitations on claim scope. . . . ("[T]he recapture rule ... ensur[es] the ability of the public to rely on a patent's public record."). The public's reliance interest provides a justification for the recapture rule that is independent of the likelihood that the surrendered territory was already covered by prior art or otherwise unpatentable. The recapture rule thus serves the same policy as does the doctrine of prosecution history estoppel: both operate, albeit in different ways, to prevent a patentee from encroaching back into territory that had previously been committed to the public. (citations omitted.)

B. *§ 251- The Examiner's Prima Facie Case*

Our Findings of Fact 38, 40, 54, 56, 96A to 96C, and 109B to 109E set out the basis upon which the Examiner made a recapture rejection. As noted in Findings of Fact 97 and 110, the record supports the Examiner's findings with respect to claims 27-29 and 31-33.

Basically, in the application which matured into the patent now sought to be reissued, the Examiner rejected originally filed independent claims 1 and 11 and their dependent claims over the prior art. Appellants proceeded to re-write original application claims 1 and 11. Amended application claims 1 and 11 ultimately issued as patent claims 1 and 8.

The Examiner made three points all as set out in Findings of Fact 96A, 96B, and 109B to 109E:

(1) when faced with a rejection in the original application, Appellants made *significant* amendments (See Findings of Fact 96A, 38, 54, 109B, and 109C);

(2) when faced with a rejection in the original application, Appellants made *significant* arguments (See Findings of Fact 109D, 40, and 56)

(3) reissue claims 27-29 and 31-33 are broader than the original patent claims with respect to each of the limitations added to overcome the rejection (See Findings of Fact 96B and 109E).

The Examiner's accurate factual analysis with respect to claims 27-29 and 31-33 demonstrates that the Examiner has made out a prima facie case of recapture consistent with the test set forth in *Clement* and amplified in *Hester*.

Thus, we hold that, with respect to the Examiner's rejection of claims 27-29 and 31-33, the burden of persuasion now shifts to the Appellants to establish that the *prosecution history* of the application, which matured into the patent sought to be reissued, establishes that a surrender of subject matter did not occur or that the reissued claims were materially narrowed.

C. *§ 251 – Appellants' Response*

(1)
Rebuttal of the Presumption of Surrender

As discussed in Section VIII. B. *supra*, the Examiner has set forth a prima facie case. We also note Findings of Fact 40 and 56 which are directed to Appellants' own statements about the inclusion in the patent claims of limitations (see Findings of Fact 38 and 54) to distinguish over the prior art.

With respect to whether reissue claims 27-29 and 31-33 are narrowed as compared with the surrendered claim subject matter (Finding of Fact 111, item (a)), the Examiner and Appellants engage in a discussion as to whether certain features are inherent. (Supp. Ans. 9-10 and Supp. Reply Br. 4-5). Such discussion is not relevant as Appellants concede that "the broader aspects of the reissue claims relate to surrendered subject matter because they were added to overcome prior art rejections." (Supp. Reply Br. 3).

Thus, Appellants do not rebut the presumption of surrender by establishing that a surrender of subject matter did not occur. Rather, Appellants argue recapture

may be overcome by establishing that the reissue claims are materially narrowed in other aspects. (Supp. Reply Br. 3).

(2)
Argument That Claims 27-29 and 31-33 Are Materially Narrowed As to an Overlooked Aspect

In the Brief, Appellants argue recapture is overcome if the reissue claims are directed to a separately patentable aspect of the invention. (Br. 15). Further, Appellants restate this argument by arguing recapture may be overcome by establishing that the reissue claims are materially narrowed in other aspects. (Supp. Reply Br. 3). In response to Appellants' argument, the Examiner asserts that "the reissue claims were not . . . narrowed, as compared with the surrendered claim subject matter only in areas not related to (not germane to) what was surrendered" (Supp. Ans. 9), "i.e., not a narrowing in the area of recapture" (Supp. Ans. 11). Appellants argue that this assertion is in error because recapture may be overcome by establishing that the reissue claims are materially narrowed in other aspects. (Supp. Reply Br. 3). We agree with Appellants' argument.

Contrary to the Examiner's belief, avoidance of the recapture rule does not require that a materially narrowing limitation of a reissue claim be related to its broader aspects surrendered in the original prosecution. This is clearly revealed by express language in a number of legal precedents including the *Pannu* decision cited by the Examiner. See Section VIII. A. (12) *supra*. Accordingly, the Examiner's belief (i.e., in order to avoid the recapture rule, reissue claims must be

materially narrowing in aspects related to the surrendered subject matter) is incompatible with the purpose served by the recapture rule exception.

In addition, a careful study of their underlying facts reveals that the authorities cited by the Examiner (Supp. Reply Br. 11) do not in any way support his position. See discussion of *Pannu* in Section VIII. A. (12) *supra*. In contrast, as correctly explained by Appellants, recapture can be avoided by showing "the reissue claims are directed to a separately patentable aspect of the invention" because "the reissue claims are materially narrowed in other overlooked aspects of the invention." (Supp. Reply Br. 7).

However, after having correctly stated the law, we do not find that Appellants have rebutted the Examiner's prima facie case of recapture. Appellants have not demonstrated that the current reissue claims are materially narrowed with respect to an overlooked aspect. Rather, Appellants have concluded without explanation that "independent claim 27 includes a narrowing limitation not present in the claims deliberately canceled in the application and that the narrowing limitation has a material aspect to it that was not previously surrendered or deliberately canceled." (Supp. Reply Br. 7). Appellants additionally conclude without explanation that "the addition of [reissue] claims 27-29 and 31-34 does not constitute recapture of subject matter surrendered in the application for the patent upon which the present reissue is based." [8] (Supp. Reply Br. 7).

While we agree that (1) the record establishes that the newly claimed aspects of the invention include a narrowing limitation not present in the claims deliberately canceled in the application, we also find that (2) Appellants have not

[8] The Examiner did not reject reissue claim 34 based on recapture.

presented any explanation to show that (a) the newly claimed aspect was *overlooked* during prosecution of the original patent application and (b) the reissue claims *patentably distinguish* over the prior art. As discussed in Section VIII. A. (12) *supra*, both are required to establish that a reissue claim has been materially narrowed and thus avoids the recapture rule. The burden is on Appellants to show that failure to claim "adding a flow of a halogen source . . ." and "forming the layer with the desired tensile stress . . ." was an oversight. See Section VIII. A. (11) *supra*. Appellants have not attempted to meet that burden.

Further, in our review of the record, we find that the Examiner presented a prima facie case rejecting:

> (1) Claims 27, 28, and 31 as not patentably distinguishing over the prior art.
>
> (2) Claims 27-29 and 31-33 as containing subject matter which was not described in the [patent] specification.
>
> (3) Claims 27-29 and 31-33 as being based upon new matter added to the patent.

And, Appellants have not convinced us of any error in these Examiner rejections. See Sections III, VI, and VII *supra*. Accordingly, these three rejections would serve to strongly counter any arguments Appellants might have made that the aspects (a) were overlooked in that they were disclosed in the patent for which reissue is sought and not claimed during prosecution thereof, and (b) are material in that they patentably distinguish over the prior art.

Thus, contrary to Appellants' contention, we conclude that an "objective observer" would not view reissue claims 27-29 and 31-33 as materially narrowed as to overlooked aspects. Therefore, Appellants' argument ultimately fails to show the Examiner erred in rejecting these claims based on recapture.

D. *Result*

The decision of the Examiner rejecting reissue claims 27-29 and 31-33 under 35 U.S.C. § 251 based on recapture is affirmed.

IX. CONCLUSIONS OF LAW

(1) Appellants have not established that the Examiner erred in rejecting claims 27-28 and 31 under 35 U.S.C. 102(b) or, in the alternative, under 35 U.S.C. § 103(a) or (e), as unpatentable over Homma.

(2-A) Appellants have not established that the Examiner erred in rejecting claims 1-10 under 35 U.S.C. § 103(a), as unpatentable over Nishiyama.

(2-B) Appellants have established that the Examiner erred in rejecting claims 27-29 and 31-34 under 35 U.S.C. § 103(a), as unpatentable over Nishiyama.

(3) Appellants have established that the Examiner erred in rejecting claims 27-29 and 31-34 under 35 U.S.C. § 103(a), as unpatentable over Weise.

(4) Appellants have not established that the Examiner erred in rejecting claims 27-29 and 31-34 under 35 U.S.C. § 112, first paragraph.

(5) Appellants have not established that the Examiner erred in rejecting claims 27-29 and 31-34 under 35 U.S.C. § 251 based upon new matter added to the patent.

(6) Appellants have not established that the Examiner erred in rejecting claims 27-29 and 31-33 under 35 U.S.C. § 251 based on recapture.

(7) Claims 1-10, 27-29, and 31-34, are not patentable.

X. DECISION

The decision of the Examiner rejecting reissue claims 27-28 and 31 over Homma is affirmed.

The decision of the Examiner rejecting reissue claims 1-10 over Nishiyama is affirmed.

The decision of the Examiner rejecting reissue claims 27-29 and 31-34 over Nishiyama is reversed.

The decision of the Examiner rejecting reissue claims 27-29 and 31-34 over Weise is reversed.

The decision of the Examiner rejecting reissue claims 27-29 and 31-34 under 35 U.S.C. § 112, first paragraph, is affirmed.

The decision of the Examiner rejecting reissue claims 27-29 and 31-34 under 35 U.S.C. § 251 based upon new matter is affirmed.

The decision of the Examiner rejecting reissue claims 27-29 and 31-33 under 35 U.S.C. § 251 based on recapture is affirmed.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED

pgc

TOWNSEND AND TOWNSEND AND CREW LLP / AMAT
TWO EMBARCADERO CENTER

Appeal 2007-3582
Application 09/187,551
Patent 5,571,571

EIGHTH FLOOR
SAN FRANCISCO CA 94111-3834

Appendix 1

Drawings of application, as filed

Brief description of the drawings of Musaka et al., U.S. Patent 5,571,571, of which the present Applicants seeks reissue (drawing sheets 1, 3, 4, and 9 are attached).

Figures 1A through 1F are cross-sectional views of semiconductor devices formed by a prior art PECVD method with the devices having conductive strips of various widths and various spacings using silane as a plasma precursor gas source of silicon.

Figure 3 is a schematic sectional view of one form of a deposition apparatus having multiple power sources which can be used to carry out the method of the present invention.

Figures 4A through 4F are cross-sectional views of semiconductor devices formed by PECVD using a power source having multiple frequencies with the devices having conductive strips of various widths and various spacings in accordance with the present invention.

Figure 5 is a schematic sectional view of another form of a deposition apparatus having multiple power sources which can be used to carry out the method of the present invention.

Figure 6 is a schematic sectional view of a deposition apparatus having a single power source which can be used to carry out the method of the present invention.

Figure 10 is a graph of fluorine concentration in atomic percent of silicon oxide films of the invention versus C_2F_6 gas flow using TEOS as the reactant gas.

Figure 11 is a graph of fluorine concentration in atomic percent of silicon oxide films of the invention versus dielectric constant.

Figure 12 is a graph of wet etch rate versus C_2F_6 gas flow using TEOS as the reactant gas for silicon oxide films of the invention.

Figure 13 is a graph of stress versus C_2F_6 gas flow using TEOS as the reactant gas for silicon oxide films of the invention.

Appendix 2

Claims Of Original Patent Application, As Filed

1. A method of forming a conformal thin film of silicon oxide on a substrate having closely spaced conductive lines thereon comprising the steps of:

forming a plasma by means of an electrical source in a vacuum chamber;

introducing into the plasma a reaction gas comprising a mixture of tetraethylorthosilicate and a preselected halogen-containing gas; and

subjecting the substrate to the plasma to deposit a high quality layer of silicon oxide onto the substrate without the formation of voids in the film.

2. The method of claim 1 wherein the halogen-containing compound is a fluorine-containing compound selected from the group consisting of CF_4, C_2F_6, NF_3, HF, CHF_3, F_2, SF_6.

3. The method of claim 1 wherein the halogen-containing gas is a halocarbon selected from the group consisting of

$$CX_4 \text{ and } CX_3 - (CX_2)_n - CX_3$$

wherein X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is halogen.

4. The method of claim 3 wherein the halogen-containing gas contains fluorine.

5. The method of claim 3 wherein the plasma is created from tetraethylorthosilicate and C_2F_6.

6. The method of claim 1 wherein the plasma is created by means of two power sources having different frequencies.

7. The method of claim 6 wherein the plasma is created by means of one power source having a frequency of about 13.56 MHz and a second power source having a frequency of between 50 KHz and 1000 KHz.

8. The method of claim 7 wherein the second power source has a frequency of about 400 KHz.

9. The method of claim 1 wherein a single power source having a frequency of about 13.56 MHz is used.

10. The method of claim 1 wherein the power source is a source of microwave power.

11. A method for forming a conformal thin film of silicon oxide over a substrate having closely spaced conductive lines thereon in a plasma chamber comprising

introducing into the chamber as a plasma precursor gas a vaporized TEOS in a carrier gas and a fluorocarbon and thereafter forming a plasma therefrom, to deposit a high quality layer of silicon oxide over said conductive lines.

12. The method according to claim 11 wherein said fluorocarbon is selected from those having the formula

$$CX_4 \text{ and } CX_3 - (CX_2)_n - CX_3$$

wherein X is hydrogen or fluorine with the proviso that at least one X is fluorine; and n is an integer of 0 to 5.

13. The method according to claim 11 wherein the ratio of silicon:fluorine in the plasma precursor gas is about 14:1.

14. The method according to claim 11 wherein the silicon oxide film contains at least about 2.5 atomic percent of fluorine.

15. The method according to claim 11 wherein the conductive lines are less than 1 micron in width and no more than 1 micron apart.

Appendix 3

July 11, 1995 Claims As Amended In Response
To Non-Final Action In Original Patent Application

(matter underlined added by the amendment)
(matter in [brackets] deleted by the amendment)

1. A method of forming a conformal thin film of silicon oxide on a substrate having [closely] spaced conductive lines thereon comprising the steps of:

mounting a substrate onto a substrate support in a vacuum chamber;

forming a plasma in a region above the substrate by means of an electrical power source in [a] the vacuum chamber;

introducing into the plasma a reaction gas comprising a mixture of tetraethylorthosilicate and a [preselected halogen-containing] fluorine-containing gas; and

subjecting the substrate to the plasma so as to deposit a [high quality] layer of silicon oxide containing fluorine onto the substrate without the formation of voids in the film.

2. The method of claim 1 wherein the halogen-containing compound is a fluorine-containing compound selected from the group consisting of CF_4, C_2F_6, NF_3, HF, CHF_3, F_2, SF_6.

3. The method of claim 1 wherein the [halogen] fluorine-containing compound is a [halocarbon] fluorocarbon selected from the group consisting of

$$CX_4 \text{ and } CX_3 - (CX_2)_n - CX_3$$

wherein X is hydrogen or [halogen] fluorine and n is an integer from 0 to 5 with the proviso that at least one X is [halogen] fluorine.

4. (Cancelled)

5. The method of claim 3 wherein the plasma is created from the tetraethylorthosilicate and C_2F_6.

6. The method of claim 1 wherein the plasma is created by means of two power sources having different frequencies.

7. The method of claim 6 wherein the plasma is created by means of one power source having a frequency of about 13.56 MHz and a second power source having a frequency of between 50 KHz and 1000 KHz.

8. The method of claim 7 wherein the second power source has a frequency of about 400 KHz.

9. The method of claim 1 wherein a single power source having a frequency of about 13.56 MHz is used.

10. The method of claim 1 wherein the power source is a source of microwave power.

11. A method [for] of forming a conformal thin film of silicon oxide over a substrate having [closely] spaced conductive lines thereon in a plasma chamber comprising

mounting a substrate in said chamber;

introducing into the chamber in a region above said substrate as a plasma precursor gas a vaporized [TEOS] tetraethylorthosilicate in a carrier gas including oxygen and a fluorocarbon and thereafter forming a plasma therefrom, so as to deposit a [high quality] layer of silicon oxide containing fluorine over said conductive lines.

12. The method according to claim 11 wherein said fluorocarbon is selected from those having the formula

$$CX_4 \text{ and } CX_3 - (CX_2)_n - CX_3$$

wherein X is hydrogen or fluorine with the proviso that at least one X is fluorine; and n is an integer of 0 to 5.

13. A method according to claim 11 wherein the plasma precursor gas contains a ratio of silicon:fluorine [in the plasma precursor gas is] of about 14:1.

14. The method according to claim 11 wherein the silicon oxide film contains at least about 2.5 atomic percent of fluorine.

15. The method according to claim 11 wherein the conductive lines are less than 1 micron in width and no more than 1 micron apart.

Appendix 4

February 12, 1996 Claims As Amended In Response To The Final Rejection In Original Patent Application and Approved For Entry By The Examiner

(matter underlined added by the amendment)
(matter in [brackets] deleted by the amendment)

1. A method of forming a conformal thin film of silicon oxide on a substrate having spaced conductive lines thereon comprising the steps of:

mounting a substrate onto a substrate support in a vacuum chamber;

forming a plasma in a region above the substrate by means of an electrical power source in the vacuum chamber;

introducing into the plasma a reaction gas comprising a mixture of tetraethylorthosilicate and a fluorine-containing halocarbon gas selected from the group consisting of

CX_4 and $CX_3 - (CX_2)_n - CX_3$

wherein X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine; and

subjecting the substrate to the plasma so as to deposit a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine onto the substrate without the formation of voids in the film.

2. and 3 (Cancelled)

4. (Previously Cancelled)

5. The method of claim 3 wherein the plasma is created from the tetraethylorthosilicate and C_2F_6.

6. The method of claim 1 wherein the plasma is created by means of two power sources having different frequencies.

7. The method of claim 6 wherein the plasma is created by means of one power source having a frequency of about 13.56 MHz and a second power source having a frequency of between 50 KHz and 1000 KHz.

8. The method of claim 7 wherein the second power source has a frequency of about 400 KHz.

9. The method of claim 1 wherein a single power source having a frequency of about 13.56 MHz is used.

10. The method of claim 1 wherein the power source is a source of microwave power.

11. A method of forming a conformal thin film of silicon oxide over a substrate having closely spaced conductive lines thereon in a plasma chamber comprising

mounting a substrate in said chamber;

introducing into the chamber in a region above said substrate as a plasma precursor gas [a] vaporized tetraethylorthosilicate in a carrier gas including oxygen and a fluorocarbon selected from the group consisting of

CX_4 and CX_3 - $(CX_2)_n$ - CX_3

wherein X is hydrogen or fluorine and n is an integer from 0 to 5 with the proviso that at least one X is fluorine;

and thereafter forming a plasma therefrom, so as to deposit a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine over said conductive lines.

12. (Cancelled).

13. A method according to claim 11 wherein the plasma precursor gas contains a ratio of silicon:fluorine of about 14:1.

14. (Cancelled)

15. The method according to claim 11 wherein the conductive lines are less than 1 micron in width and no more than 1 micron apart.

Appendix 5

June 14, 1996 Claim 1 As **Further** Amended In Response To The Final Rejection In Original Patent Application and Approved For Entry By The Examiner

And claim 5 as amended by the Examiner at allowance

(matter underlined added by the amendment)
(matter in [brackets] deleted by the amendment)

1. A method of forming a conformal thin film of silicon oxide on a substrate having spaced conductive lines thereon comprising the steps of:

mounting a substrate onto a substrate support in a vacuum chamber;

forming a plasma in the vacuum chamber in a region above the substrate by means of an electrical power source [in the vacuum chamber;] [introducing into the plasma] from a reaction gas comprising a mixture of tetraethylorthosilicate and a fluorine-containing halocarbon gas selected from the group consisting of

CX_4 and CX_3 - $(CX_2)_n$ - CX_3

wherein X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine; and

subjecting the substrate to the plasma so as to deposit a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine onto the substrate without the formation of voids in the film.

5. The method of claim 1 [3] wherein the plasma is created from the tetraethylorthosilicate and C_2F_6.

Appendix 6

CLAIMS OF U.S. PATENT 5,571,571, AS RENUMBERED AT ALLOWANCE

1. A method of forming a conformal thin film of silicon oxide on a substrate having spaced conductive lines thereon comprising the steps of:

mounting a substrate onto a substrate support in a vacuum chamber;

forming a plasma in the vacuum chamber in a region above the substrate by means of an electrical power source from a reaction gas comprising a mixture of tetraethylorthosilicate and a fluorine-containing halocarbon gas selected from the group consisting of

CX_4 and $CX_3 - (CX_2)_n - CX_3$

wherein X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine; and

subjecting the substrate to the plasma so as to deposit a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine onto the substrate without the formation of voids in the film.

2. The method of claim 1 wherein the plasma is created from the tetraethylorthosilicate and C_2F_6.

3. The method of claim 1 wherein the plasma is created by means of two power sources having different frequencies.

4. The method of claim 3 wherein the plasma is created by means of one power source having a frequency of about 13.56 MHz and a second power source having a frequency of between 50 KHz and 1000 KHz.

5. The method of claim 4 wherein the second power source has a frequency of about 400 KHz.

6. The method of claim 1 wherein a single power source having a frequency of about 13.56 MHz is used.

7. The method of claim 1 wherein the power source is a source of microwave power.

8. A method of forming a conformal thin film of silicon oxide over a substrate having closely spaced conductive lines thereon in a plasma chamber comprising

mounting a substrate in said chamber;

introducing into the chamber in a region above said substrate as a plasma precursor gas vaporized tetraethylorthosilicate in a carrier gas including oxygen and a fluorocarbon selected from the group consisting of

$$CX_4 \text{ and } CX_3 - (CX_2)_n - CX_3$$

wherein X is hydrogen or fluorine and n is an integer from 0 to 5 with the proviso that at least one X is fluorine;

and thereafter forming a plasma therefrom, so as to deposit a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine over said conductive lines.

9. A method according to claim 8 wherein the plasma precursor gas contains a ratio of silicon:fluorine of about 14:1.

10. The method according to claim 8 wherein the conductive lines are less than 1 micron in width and no more than 1 micron apart.

Appendix 7

Claims Of Reissue Application, As Filed November 5, 1998

(matter underlined added by the amendment)
(matter in [brackets] deleted by the amendment)

1. A method of forming a conformal thin film of silicon oxide on a substrate having spaced conductive lines thereon comprising the steps of:

mounting a substrate onto a substrate support in a vacuum chamber;

forming a plasma in the vacuum chamber in a region above the substrate by means of an electrical power source from a reaction gas comprising a mixture of tetraethylorthosilicate and a fluorine-containing halocarbon gas selected from the group consisting of

CX_4 and $CX_3 - (CX_2)_n - CX_3$

wherein X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine; and

subjecting the substrate to the plasma so as to deposit a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine onto the substrate without the formation of voids in the film.

2. The method of claim 1 wherein the plasma is created from the tetraethylorthosilicate and C_2F_6.

3. The method of claim 1 wherein the plasma is created by means of two power sources having different frequencies.

4. The method of claim 3 wherein the plasma is created by means of one power source having a frequency of about 13.56 MHz and a second power source having a frequency of between 50 KHz and 1000 KHz.

5. The method of claim 4 wherein the second power source has a frequency of about 400 KHz.

6. The method of claim 1 wherein a single power source having a frequency of about 13.56 MHz is used.

7. The method of claim 1 wherein the power source is a source of microwave power.

8. A method of forming a conformal thin film of silicon oxide over a substrate having closely spaced conductive lines thereon in a plasma chamber comprising

mounting a substrate in said chamber;

introducing into the chamber in a region above said substrate as a plasma precursor gas vaporized tetraethylorthosilicate in a carrier gas including oxygen and a fluorocarbon selected from the group consisting of

$$CX_4 \text{ and } CX_3 - (CX_2)_n - CX_3$$

wherein X is hydrogen or fluorine and n is an integer from 0 to 5 with the proviso that at least one X is fluorine;

and thereafter forming a plasma therefrom, so as to deposit a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine over said conductive lines.

9. A method according to claim 8 wherein the plasma precursor gas contains a ratio of silicon:fluorine of about 14:1.

10. A method according to claim 8 wherein the conductive lines are less than 1 micron in width and no more than 1 micron apart.

11. through 26. (New reissue claims which were cancelled in response to the **First** non-final Action and which we do not deem necessary to reproduce.)

Appendix 8

December 22, 1999 Reissue Claims As Amended In Response To **First** Non-Final Action

(matter underlined added by the amendment)
(matter in [brackets] deleted by the amendment)

1. A method of forming a conformal thin film of silicon oxide on a substrate having spaced conductive lines thereon comprising the steps of:

mounting a substrate onto a substrate support in a vacuum chamber;

forming a plasma in the vacuum chamber in a region above the substrate by means of an electrical power source from a reaction gas comprising a mixture of tetraethylorthosilicate and a fluorine-containing halocarbon gas selected from the group consisting of

[CX_4] CY_4 and CX_3 - $(CX_2)_n$ - CX_3

wherein X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine; and

subjecting the substrate to the plasma so as to deposit a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine onto the substrate without the formation of voids in the film.

2. The method of claim 1 wherein the plasma is created from the tetraethylorthosilicate and C_2F_6.

3. The method of claim 1 wherein the plasma is created by means of two power sources having different frequencies.

4. The method of claim 3 wherein the plasma is created by means of one power source having a frequency of about 13.56 MHz and a second power source having a frequency of between 50 KHz and 1000 KHz.

5. The method of claim 4 wherein the second power source has a frequency of about 400 KHz.

6. The method of claim 1 wherein a single power source having a frequency of about 13.56 MHz is used.

7. The method of claim 1 wherein the power source is a source of microwave power.

8. A method of forming a conformal thin film of silicon oxide over a substrate having closely spaced conductive lines thereon in a plasma chamber comprising

mounting a substrate in said chamber;

introducing into the chamber in a region above said substrate as a plasma precursor gas vaporized tetraethylorthosilicate in a carrier gas including oxygen and a fluorocarbon selected from the group consisting of

$[CX_4]$ $\underline{CY_4}$ and $CX_3 - (CX_2)_n - CX_3$

wherein X is hydrogen or fluorine and n is an integer from 0 to 5 with the proviso that at least one X is fluorine and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine;

and thereafter forming a plasma therefrom, so as to deposit a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine over said conductive lines.

9. A method according to claim 8 wherein the plasma precursor gas contains a ratio of silicon:fluorine of about 14:1.

10. A method according to claim 8 wherein the conductive lines are less than 1 micron in width and no more than 1 micron apart.

11. through 26. (Cancelled)

27. (New) A method of forming a layer of silicon oxide over a substrate having spaced conductive lines thereon in a process chamber, the method comprising:

introducing a selected process gas comprising silicon and oxygen into the process chamber;

adding a flow of a halogen source to the selected process gas at a flow rate previously determined to achieve a desired stress in the layer from a plasma enhanced reaction of the selected process gas and the flow of the halogen source at the flow rate, the desired stress in the layer being a tensile stress instead of a compressive stress in a layer formed from a plasma enhanced reaction of the selected process gas without the flow of the halogen source; and

forming a layer from a plasma enhanced reaction of the selected process gas and the flow of the halogen source at the flow rate.

28. (New) The method of claim 27 wherein the halogen source comprises a fluorine source.

29. (New) The method of claim 28 wherein the fluorine source is selected from the group consisting of CF_4 and C_2F_6.

30. (New) The method of claim 27 wherein the silicon source comprises tetraethylorthosilicate.

31. (New) The method of claim 27 wherein the desired tensile stress is less than about $0.4X10^9$ dynes/cm^2 in magnitude.

32. (New) The method of claim 31 wherein the silicon source comprises tetraethylorthosilicate and the fluorine source comprises C_2F_6.

33. (New) The method of claim 27 wherein the selected process gas comprises a mixture of tetraethylorthosilicate and a fluorine-containing halocarbon gas selected from the group consisting of CY_4 and $CX_3 - (CX_2)_n - CX_3$, wherein X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine, and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine.

34. (New) The method of claim 33 wherein the layer of silicon oxide contains at least about 2.5 atomic percent of fluorine over the conductive lines.

Appendix 9

June 16, 2000 Reissue Claims As Amended In Response To **First** Final Rejection

(matter underlined added by the amendment)
(matter in [brackets] deleted by the amendment)

1. A method of forming a conformal thin film of silicon oxide on a substrate having spaced conductive lines thereon comprising the steps of:

mounting a substrate onto a substrate support in a vacuum chamber;

forming a plasma in the vacuum chamber in a region above the substrate by means of an electrical power source from a reaction gas comprising a mixture of tetraethylorthosilicate and a fluorine-containing halocarbon gas selected from the group consisting of

$[CX_4]$ CY_4 and $CX_3 - (CX_2)_n - CX_3$

wherein X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine; and

subjecting the substrate to the plasma so as to deposit a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine onto the substrate without the formation of voids in the film.

2. The method of claim 1 wherein the plasma is created from the tetraethylorthosilicate and C_2F_6.

3. The method of claim 1 wherein the plasma is created by means of two power sources having different frequencies.

4. The method of claim 3 wherein the plasma is created by means of one power source having a frequency of about 13.56 MHz and a second power source having a frequency of between 50 KHz and 1000 KHz.

5. The method of claim 4 wherein the second power source has a frequency of about 400 KHz.

6. The method of claim 1 wherein a single power source having a frequency of about 13.56 MHz is used.

7. The method of claim 1 wherein the power source is a source of microwave power.

8. A method of forming a conformal thin film of silicon oxide over a substrate having spaced conductive lines thereon in a plasma chamber comprising

mounting a substrate in said chamber;

introducing into the chamber in a region above said substrate as a plasma precursor gas vaporized tetraethylorthosilicate in a carrier gas including oxygen and a fluorocarbon selected from the group consisting of

$[CX_4]$ CY_4 and $CX_3 - (CX_2)_n - CX_3$

wherein X is hydrogen or fluorine and n is an integer from 0 to 5 with the proviso that at least one X is fluorine and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine;

and thereafter forming a plasma therefrom, so as to deposit a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine over said conductive lines.

9. A method according to claim 8 wherein the plasma precursor gas contains a ratio of silicon:fluorine of about 14:1.

10. A method according to claim 8 wherein the conductive lines are less than 1 micron in width and no more than 1 micron apart.

27. A method of forming a layer of silicon oxide over a substrate having spaced conductive lines thereon in a process chamber, the method comprising:

introducing a selected process gas comprising [silicon] tetraethylorthosilicate and oxygen into the process chamber;

adding a flow of a halogen source to the selected process gas at a flow rate previously determined to achieve a desired stress in the layer from a plasma enhanced reaction of the selected process gas and the flow of the halogen source at the flow rate, the desired stress in the layer being a tensile stress instead of a compressive stress in another [a] layer formed from another [a] plasma enhanced reaction of the selected process gas without the flow of the halogen source; and

forming the [a] layer from the [a] plasma enhanced reaction of the selected process gas and the flow of the halogen source at the flow rate.

28. The method of claim 27 wherein the halogen source comprises a fluorine source.

29. The method of claim 28 wherein the fluorine source is selected from the group consisting of CF_4 and C_2F_6.

30. (Cancelled)

31. The method of claim 27 wherein the desired tensile stress is less than about $0.4X10^9$ dynes/cm^2 in magnitude.

32. The method of claim 31 wherein [the silicon source comprises tetraethylorthosilicate and] the fluorine source comprises C_2F_6.

33. The method of claim 27 wherein the selected process gas comprises a mixture of tetraethylorthosilicate and a fluorine-containing halocarbon gas selected from the group consisting of CY_4 and $CX_3 - (CX_2)_n - CX_3$, wherein X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine, and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one is fluorine.

34. The method of claim 33 wherein the layer of silicon oxide contains at least about 2.5 atomic percent of fluorine over the conductive lines.

Appendix 10

March 5, 2001 Reissue Claims As Amended In Response To **Second** Non-Final Action

(matter underlined added by the amendment)
(matter in [brackets] deleted by the amendment)

1. A method of forming a conformal thin film of silicon oxide on a substrate having spaced conductive lines thereon comprising the steps of:

mounting a substrate onto a substrate support in a vacuum chamber;

forming a plasma in the vacuum chamber in a region above the substrate by means of an electrical power source from a reaction gas comprising a mixture of tetraethylorthosilicate and a fluorine-containing halocarbon gas selected from the group consisting of

$[CX_4]$ CY_4 and $CX_3 - (CX_2)_n - CX_3$

wherein X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine; and

subjecting the substrate to the plasma so as to deposit a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine onto the substrate without the formation of voids in the film.

2. The method of claim 1 wherein the plasma is created from the tetraethylorthosilicate and C_2F_6.

3. The method of claim 1 wherein the plasma is created by means of two power sources having different frequencies.

4. The method of claim 3 wherein the plasma is created by means of one power source having a frequency of about 13.56 MHz and a second power source having a frequency of between 50 KHz and 1000 KHz.

5. The method of claim 4 wherein the second power source has a frequency of about 400 KHz.

6. The method of claim 1 wherein a single power source having a frequency of about 13.56 MHz is used.

7. The method of claim 1 wherein the power source is a source of microwave power.

8. A method of forming a conformal thin film of silicon oxide over a substrate having closely spaced conductive lines thereon in a plasma chamber comprising

mounting a substrate in said chamber;

introducing into the chamber in a region above and substrate as a plasma precursor gas vaporized tetraethylorthosilicate in a carrier gas including oxygen and a fluorocarbon selected from the group consisting of

$[CX_4]$ CY_4 and CX_3 - $(CX_2)_n$ - CX_3

wherein X is hydrogen or fluorine and n is an integer from 0 to 5 with the proviso that at least one X is fluorine and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine;

and thereafter forming a plasma therefrom, so as to deposit a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine over said conductive lines.

9. A method according to claim 8 wherein the plasma precursor gas contains a ratio of silicon:fluorine of about 14:1.

10. A method according to claim 8 wherein the conductive lines are less than 1 micron in width and no more than 1 micron apart.

27. A method of forming a layer of silicon oxide over a substrate having spaced conductive lines thereon in a process chamber, the method comprising:

introducing a selected process gas comprising tetraethylorthosilicate and oxygen into the process chamber;

adding a flow of a halogen source to the selected process gas at a flow rate previously determined to achieve a desired stress in the layer from a plasma enhanced reaction of the selected process gas and the flow of the halogen source at the flow rate, the desired stress in the layer being a tensile stress instead of a compressive stress in another layer formed from another plasma enhanced reaction of the selected process gas without the flow of the halogen source; and

forming the layer with the desired tensile stress from the plasma enhanced reaction of the selected process gas and the flow of the halogen source at the flow rate.

28. The method of claim 27 wherein the halogen source comprises a fluorine source.

29. The method of claim 28 wherein the fluorine source is selected from the group consisting of CF_4 and C_2F_6.

31. The method of claim 27 wherein the desired tensile stress is less than about $0.4X10^9$ dynes/cm^2 in magnitude.

32. The method of claim 31 wherein the fluorine source comprises C_2F_6.

33. The method of claim 27 wherein the selected process gas comprises a mixture of the tetraethylorthosilicate and a fluorine-containing halocarbon gas selected from the group consisting of CY_4 and $CX_3 - (CX_2)_n - CX_3$, wherein X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine, and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine.

34. The method of claim 33 wherein the layer of silicon oxide contains at least about 2.5 atomic percent of fluorine over the conductive lines.

Appendix 11

The Reissue Claims On Appeal

1. A method of forming a conformal thin film of silicon oxide on a substrate having spaced conductive lines thereon comprising the steps of:

mounting a substrate onto a substrate support in a vacuum chamber;

forming a plasma in the vacuum chamber in a region above the substrate by means of an electrical power source from a reaction gas comprising a mixture of tetraethylorthosilicate and a fluorine-containing halocarbon gas selected from the group consisting of

CY_4 and $CX_3 - (CX_2)_n - CX_3$

wherein X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine; and

subjecting the substrate to the plasma so as to deposit a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine onto the substrate without the formation of voids in the film.

2. The method of claim 1 wherein the plasma is created from the tetraethylorthosilicate and C_2F_6.

3. The method of claim 1 wherein the plasma is created by means of two power sources having different frequencies.

4. The method of claim 3 wherein the plasma is created by means of one power source having a frequency of about 13.56 MHz and a second power source having a frequency of between 50 KHz and 1000 KHz.

5. The method of claim 4 wherein the second power source has a frequency of about 400 KHz.

6. The method of claim 1 wherein a single power source having a frequency of about 13.56 MHz is used.

7. The method of claim 1 wherein the power source is a source of microwave power.

8. A method of forming a conformal thin film of silicon oxide over a substrate having spaced conductive lines thereon in a plasma chamber comprising

mounting a substrate in said chamber;

introducing into the chamber in a region above said substrate as a plasma precursor gas vaporized tetraethylorthosilicate in a carrier gas including oxygen and a fluorocarbon selected from the group consisting of

$$CY_4 \text{ and } CX_3 - (CX_2)_n - CX_3$$

wherein X is hydrogen or fluorine and n is an integer from 0 to 5 with the proviso that at least one X is fluorine and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine;

and thereafter forming a plasma therefrom, so as to deposit a layer of silicon oxide containing at least about 2.5 atomic percent of fluorine over said conductive lines.

9. A method according to claim 8 wherein the plasma precursor gas contains a ratio of silicon:fluorine of about 14:1.

10. A method according to claim 8 wherein the conductive lines are less than 1 micron in width and no more than 1 micron apart.

27. A method of forming a layer of silicon oxide over a substrate having spaced conductive lines thereon in a process chamber, the method comprising:

introducing a selected process gas comprising tetraethylorthosilicate and oxygen into the process chamber;

adding a flow of a halogen source to the selected process gas at a flow rate previously determined to achieve a desired stress in the layer from a plasma enhanced reaction of the selected process gas and the flow of the halogen source at the flow rate, the desired stress in the layer being a tensile stress instead of a compressive stress in another layer formed from another plasma enhanced reaction of the selected process gas without the flow of the halogen source; and

forming the layer with the desired tensile stress from the plasma enhanced reaction of the selected process gas and the flow of the halogen source at the flow rate.

28. The method of claim 27 wherein the halogen source comprises a fluorine source.

29. The method of claim 28 wherein the fluorine source is selected from the group consisting of CF_4 and C_2F_6.

31. The method of claim 27 wherein the desired tensile stress is less than about $0.4X10^9$ dynes/cm^2 in magnitude.

32. The method of claim 31 wherein the fluorine source comprises C_2F_6.

33. The method of claim 27 wherein the selected process gas comprises a mixture of the tetraethylorthosilicate and a fluorine-containing halocarbon gas selected from the group consisting of CY_4 and CX_3 - $(CX_2)_n$ - CX_3, wherein X is hydrogen or halogen and n is an integer from 0 to 5 with the proviso that at least one X is fluorine, and wherein Y is hydrogen or halogen and at least one Y is hydrogen and at least one Y is fluorine.

34. The method of claim 33 wherein the layer of silicon oxide contains at least about 2.5 atomic percent of fluorine over the conductive lines.

Appendix 12

All paragraphs describing stress in the
Description of Musaka et al., U.S. Patent 5,571,571,
of which the present Applicants seeks reissue (**Bold** emphasis added)

(Column 3, lines 21-41)

Weise et al, PCT application US92/04103, describes the reaction on an inorganic substrate of unsubstituted silane (SiH_4) together with a halogen-containing gas and an oxygen-containing gas by PECVD or ECR CVD techniques. Alternatively the precursor gas can be an organosilane. An etchant is added along with the precursor gas or gases. Suitable etchants listed include fluorine-containing compounds and halogens, but the preferred etchants are HF or NF_3. Sulfur-based or carbon-based etchants are not preferred however, because it is stated that residual sulfur or carbon remains in the films, which is undesirable. Halogens are not preferred either, because they corrode the reaction chamber and other equipment. As is well known, NF_3 and HF are also corrosive, particularly to quartz parts. The addition of NF_3 to the silicon oxide film reduces **intrinsic stress** in the film, and also reduces the amount of hydrogen present in the film, which has a high dielectric constant. However, this process leads to films having **low compressive stress**, which leads to semiconductor devices with unsatisfactory electrical properties, and inferior mechanical properties. The process also exhibits low deposition rates.

(Column 4, lines 46-48)

FIG. 13 is a **graph of stress** versus C_2F_6 gas flow using TEOS as the reactant gas for silicon oxide films of the invention.

(Column 6, lines 26-45)

When the widths of the respective aluminum strips and of the corresponding spaces between the strips are comparatively large, as shown in FIGS. 4A to 4D, the sidewalls of the silicon dioxide layers 72a to 72d have a smoothly tapered configuration. However, even when the widths of the respective aluminum strips and of the corresponding spaces between the strips is in the submicron range, as shown in FIG. 4E, the sidewall configuration of the silicon dioxide layer 72e is

straight, and the possible creation of voids is greatly reduced. When the width of the respective aluminum strips and the corresponding spaces therebetween is reduced even further, in the submicron range, as shown in FIG. 4F, the spaces between the aluminum strips 70f are buried by the silicon oxide layer 78f, without the formation of any voids in the film. Since the sidewalls obtained with the configurations shown in FIGS. 4E and 4F have a fine compositional structure, an enhancement of the quality is achieved. The **compressive stress** of the above film was found to be $1X10^9$ dynes/cm^2.

(Column 8, lines 21-25)

The silicon oxide film obtained contained about 4.3% of fluorine. In this case, using a single frequency, the deposition rate of the silicon oxide was reduced to about 2500-3000 angstroms per minute. The **compressive stress** of this film was about $2X10^8$ dynes/cm^2.

(Column 8, line 66, through column 9, line 6)

The application of low frequency power decreases the deposition rate, but **improves compressive stress**, slightly increases the wet etch rate, lowers R.I. and increases the gap filling capability. The application of high frequency power slightly reduces the deposition rate, **does not affect the compressive stress** of the films, slightly increases the wet etch rate, slightly decreases the R.I. and slightly increases the gap filling capability.

(Column 9, lines 28-30)

FIG. 13 is a graph of C_2F_6 gas flow versus stress of the silicon oxide films, showing **reduced stress** with higher C_2F_6 flow rates and higher fluorine concentration in the films.